FOURTH FIVE-YEAR REVIEW REPORT
OPERABLE UNITS 2 AND 4
SCHOFIELD BARRACKS
HONOLULU COUNTY, HAWAII

AEDB-R Nos. SCHBR-19 and SCHBR-12

PREPARED FOR

U.S. Army
U.S. Army Garrison-Hawaii
Honolulu County, Hawaii

and

U.S. Army Environmental Command
Fort Sam Houston, Texas

September 2017

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Approved by:

Stephen Dawson — *Signature*

11/7/17 — *Date*

Stephen E. Dawson
Colonel, U.S. Army
Commanding

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HONOLULU COUNTY, HAWAII

Prepared by:

U.S. Army Corps of Engineers
Seattle District
Seattle, Washington

Executive Summary

The U.S. Army Garrison-Hawaii's Schofield Barracks (Schofield Barracks; AEDB-R Nos. SCHBR-19 and SCHBR-12) is located on Oahu, Hawaii, approximately 22 miles northwest of the City of Honolulu. It is the Army's largest installation outside the continental United States and home to the Army's 25th Infantry Division. The Schofield Barracks encompasses approximately 27.7 square miles.

This is the fourth Five-Year Review (FYR) for two Operable Units (OUs) at Schofield Barracks: OU 2, the groundwater, and OU 4, the former landfill. This FYR evaluates the protectiveness of the remedies implemented at those OUs. OU 1 and OU 3 achieved no further action during their respective remedial investigations, and thus do not require FYRs.

The groundwater beneath Schofield Barracks (OU 2) is contaminated with trichloroethylene (TCE) and carbon tetrachloride. The remedy for OU 2 includes wellhead treatment for extracted groundwater that is used for drinking water, and long-term monitoring of the groundwater. Treatment is required to meet the maximum contaminant level (MCL) for use in the drinking water system. The hydrogeology on Oahu is very complex, which led the U.S. Environmental Protection Agency (EPA) to grant a Technical Impracticability waiver for restoration of groundwater to the MCL. The results of the FYR show that the remedy is functioning as intended and no changes have occurred to the site that might call into question the protectiveness of the remedy. The remedy for OU 2 is protective of human health and the environment.

The former landfill at Schofield Barracks (OU 4) was determined to be the source of carbon tetrachloride contamination in the groundwater and one of several potential sources of TCE contamination in the groundwater. The remedy for OU 4 included repairing the former landfill's cap and maintaining the cap and access restrictions. The results of the FYR show that the remedy is functioning as intended and no changes have occurred to the site that might call into question the protectiveness of the remedy. The remedy for OU 4 is protective of human health and the environment.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Schofield Barracks		
EPA ID: HI7210090026 **AEDB-R Nos.:** SCHBR-19 and SCHBR-12		
Region: 9	**State:** HI	**City/County:** Schofield Barracks, Honolulu County

SITE STATUS	
NPL Status: Deleted	
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes

REVIEW STATUS
Lead agency: Other Federal Agency **If "Other Federal Agency" was selected above, enter Agency name:** U.S. Army Garrison-Hawaii
Author name: Kayla Patten
Author affiliation: U.S. Army Corps of Engineers, Seattle District
Review period: 1 June 2016 – 1 September 2017
Date of site inspection: 18 January 2017
Type of review: Statutory
Review number: 4
Triggering action date: 10 September 2012
Due date: 10 September 2017

Five-Year Review Summary Form

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the Five-Year Review:
OU 2 and OU 4

Protectiveness Statements	
Operable Unit: 2	*Protectiveness Determination:* Protective
Protectiveness Statement: The remedy at OU 2 is protective of human health and the environment.	
Operable Unit: 4	*Protectiveness Determination:* Protective
Protectiveness Statement: The remedy at OU 4 is protective of human health and the environment.	

Sitewide Protectiveness Statement
Protectiveness Determination: Protective
Protectiveness Statement: The remedies at the Schofield Barracks are protective of human health and the environment.

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List of Abbreviations

ARAR	applicable or relevant and appropriate
ASTS	air stripper treatment system
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminant of concern
DoD	Department of Defense
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
FS	feasibility study
FYR	Five-Year Review
IUR	inhalation unit risk
LTM	long-term monitoring
MCL	maximum contaminant level
NCP	National Contingency Plan
NPL	National Priorities List
O&M	operations and maintenance
OU	operable unit
RAO	remedial action objective
RI	remedial investigation
RfC	reference concentration
RfD	reference dose
ROD	Record of Decision
SDWA	Safe Drinking Water Act
SF	slope factor
TCE	trichloroethylene
TI	technical impracticability
USACE	United States Army Corps of Engineers
USAG-HI	U.S. Army Garrison-Hawaii
USPACOM	United States Pacific Command
WTP	water treatment plant
µg/L	micrograms per liter

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1. Introduction

The U.S. Army Garrison Hawaii's (USAG-HI's) Schofield Barracks (Schofield Barracks; EPA ID: HI7210090026) is an Army installation located on the island of Oahu, Hawaii. Four operable units (OUs) were established at the Schofield Barracks to address potential areas of contamination:

- OU 1 – Possible TCE Sources
- OU 2 – Groundwater Contamination
- OU 3 – Basewide Miscellaneous Sites
- OU 4 – Former Landfill

This Five-Year Review (FYR) addresses the remedial actions taken for OU 2 and OU 4 (AEDB-R Nos. SCHBR-19 and SCHBR-12). As documented in the Records of Decisions (RODs) for OU 1 and OU 3, no remedial actions were required. Therefore, OU 1 and OU 3 are not included in this FYR.

This is the fourth FYR for OUs 2 and 4. The triggering action[1] for this FYR is the signing of the previous FYR, which was on 10 September 2012. This FYR is due five years after the triggering date on 10 September 2017.

1.1. Purpose

The purpose of a FYR is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports. In addition, FYR reports identify issues found during the review, if any, and provide recommendations to address them.

1.2. Authority

The USAG-HI is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Contingency Plan (NCP). CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such*

[1] The triggering action is the activity that initiates the five year review process. Initial Five-Year Review reports are triggered by one of several activities, such as signature of a decision document or construction of the remedy. Subsequent Five-Year Reviews are typically triggered by the signature of the previous Five-Year Review report. (EPA, 2001)

reviews, and any actions taken as a result of such reviews.

The NCP, at 40 CFR §300.430(f)(4)(ii), further states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

After Schofield Barracks was placed on the National Priorities List (NPL), a federal facility agreement (FFA) was negotiated with the U.S. Environmental Protection Agency (EPA), the State of Hawaii, and USAG-HI under CERCLA, Section 120. The FFA was signed by USAG-HI on 23 September 1991, by EPA on 27 September 1991, and by the State of Hawaii Department of Health on 5 June 1996. The FFA identified Schofield Barracks as being under the jurisdiction, custody, or control of the U.S. Department of Defense (DoD) and subject to the Defense Environmental Restoration Program.

The U.S. Army Corps of Engineers (USACE) has conducted this fourth FYR of the remedial actions implemented at OUs 2 and 4 at the Schofield Barracks. This review was conducted from June 2016 through September 2017. This report documents the results of the review.

2. Site Chronology

A chronology of significant activities associated with OUs 2 and 4 is listed in Table 1.

Table 1. Chronology of Site Events

Event	Date
Landfill used as open burn dump	1942 to 1967
Landfill converted to sanitary landfill	1967
Landfill operations ceased	1981
Landfill closed	1983
TCE detected in Schofield Barracks supply wells	April 1985
Schofield Barracks temporarily switched to city and county water supplies	May 1985
Air stripping treatment unit installed at the water treatment plant (WTP) to treat water from Schofield supply wells	September 1986
Schofield Barracks was placed on the NPL	August 1990
A Federal Facility Agreement (FFA) was negotiated with the EPA, the State of Hawaii, and USAG-HI	September 1991
Preliminary Assessment/Site Investigation for OUs 2 and 4 was completed	May 1992
A Community Relations Plan for Schofield Barracks was completed	June 1992
Remedial Investigation/Feasibility Study (RI/FS) for OU 4 was completed	December 1995
RI/FS for OU 2 was completed	February 1996
Record of Decision (ROD) for OU 4 completed	September 1996

Event	Date
ROD for OU 2 completed	February 1997
OU 2 Long-Term Monitoring Program implemented	April 1997
OU 4 Long-Term Monitoring Program implemented	June 1998
OU 4 remedial action completed	July 1998
Schofield Barracks removed from the NPL	August 2000
First FYR completed	September 2002
Sampling frequency of various OU 2 and OU 4 wells decreases	October 2002
TCE and PCE detected at Sandwich Isles Communication exploratory wells	2005
Sampling frequency of various OU 2 and OU 4 wells decreases	December 2005
EPA approves of Addenda to Final Operations and Maintenance (O&M) and Long Term Groundwater Monitoring Plans for OU 2 and OU 4	July 2006
Second FYR completed	September 2007
Sandwich Isles air stripper treatment system (ASTS) installed	September 2011
Third FYR completed	September 2012
Sandwich Isles ASTS decommissioned due to lack of need for treated water	2014

3. Background

Schofield Barracks is located on the Schofield Plateau between the Waianae and Koolau Mountain Ranges in central Oahu (Figure 1). It is the Army's largest installation outside the continental United States. It currently serves primarily as the home of the 25th Infantry Division, whose mission is to be prepared for deployment to a theater of operations to perform combat operations as part of a corps counterattack. It conducts theater-wide deployment within 54 hours of notification to perform combat operations in support of the United States Pacific Command (USPACOM) theater strategy. In support of this mission, the Division's main activity is training. Installation facilities include a medical facility, community and housing support facilities, and transportation and repair facilities.

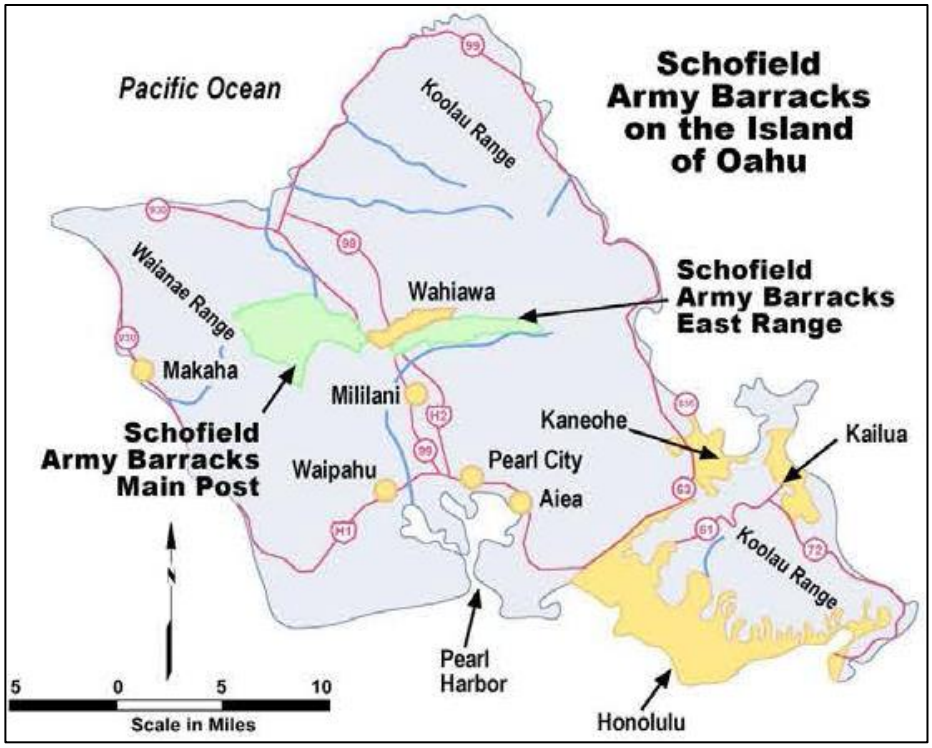

Figure 1. Location Map of Schofield Barracks
Figure Source: AEC and DPW, 2012

3.1. Physical Characteristics

Schofield Barracks is located approximately 22 miles northwest of the City of Honolulu. The closest municipality is Wahiawa, which is immediately north of the Schofield Barracks. The installation encompasses approximately 27.7 square miles, and is divided into three sections: the East Range, the Main Post or Barracks in the west, and the South Range Acquisition Area.

OU 2 consists of the groundwater beneath Schofield Barracks, which is contaminated with trichloroethylene (TCE) and carbon tetrachloride. The groundwater is 550 to 650 feet below ground surface and is part of the groundwater body underlying the Schofield Plateau known as the Schofield High-Level Water Body (Figure 3).

OU 4 (Figure 2) consists of a former landfill located in the northwestern section of Schofield Barracks. OU 4 was identified as the source of carbon tetrachloride to the groundwater (OU 2); however, a source for the TCE was not identified (HLA, 1996b).

The water table (potentiometric surface) elevation of the Schofield High-Level Water Body is approximately 275 feet above mean sea level. This elevation is lower than the adjacent dike-impounded water bodies to the east (Koolau Mountain Range) and west (Waianae Mountain Range) and higher than the basal water bodies to the north (Waialua Basal Water Body) and south (Honolulu-Pearl Harbor Basal Water Body) that have elevations of less than 50 feet above mean sea level.

The northern and southern boundaries of the Schofield High-Level Water Body (characterized as groundwater dams) have been inferred from water-level measurements in domestic and irrigation wells on either side of the groundwater dams and by geophysical surveys. The groundwater dams impede groundwater flow to the Honolulu-Pearl Harbor and Waialua Basal Water Bodies. However, the nature and locations of these water body boundaries are not precisely known.

The climate at Schofield Barracks is characterized by moderate temperatures that remain relatively constant throughout the year. The average annual rainfall in the vicinity of Schofield Barracks is approximately 1.2 meters, more than half of which occurs during the rainy season from November through February (HCS, 2009).

3.2. Land and Resource Use

Schofield Barracks was originally established in 1908 as a base for the Army's mobile defense of Pearl Harbor and the Island of Oahu. It served as a major support facility during World War II, temporarily housing more than one million troops. It also served as a support and training facility during the Korean and Vietnam wars. Since the Vietnam War, it has served primarily as a training facility.

The installation is divided into three sections: the Schofield Barracks Main Post, the Schofield Barracks East Range, and the South Range Acquisition Area. The towns of Wahiawa and Mililani, other military properties, and private properties are adjacent to Schofield Barracks. Some of the private properties are used for agricultural purposes such as growing sugar cane and pineapples.

Groundwater is the principal source of drinking water for the population of Oahu and is the source of fresh water for other uses such as agriculture. Most of the groundwater wells in the Schofield Barracks area are used as municipal water supplies or have irrigation uses.

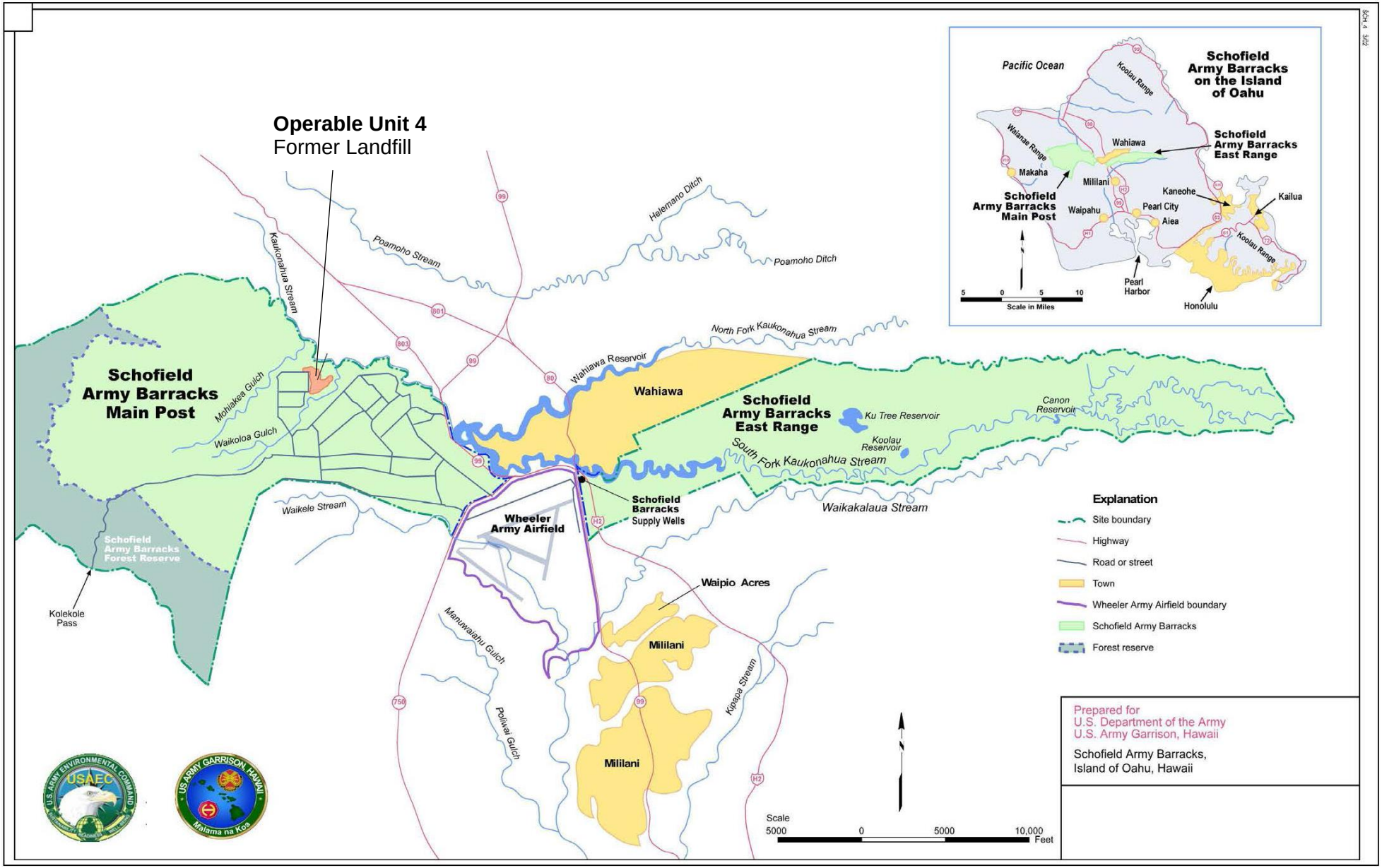

Figure 2. Site Location Map of OU 2 and OU 4.

Note: OU 2 (groundwater) does not have a defined boundary. OU 2 is the groundwater in this general location.
Figure adapted from: AEC and DPW, 2012

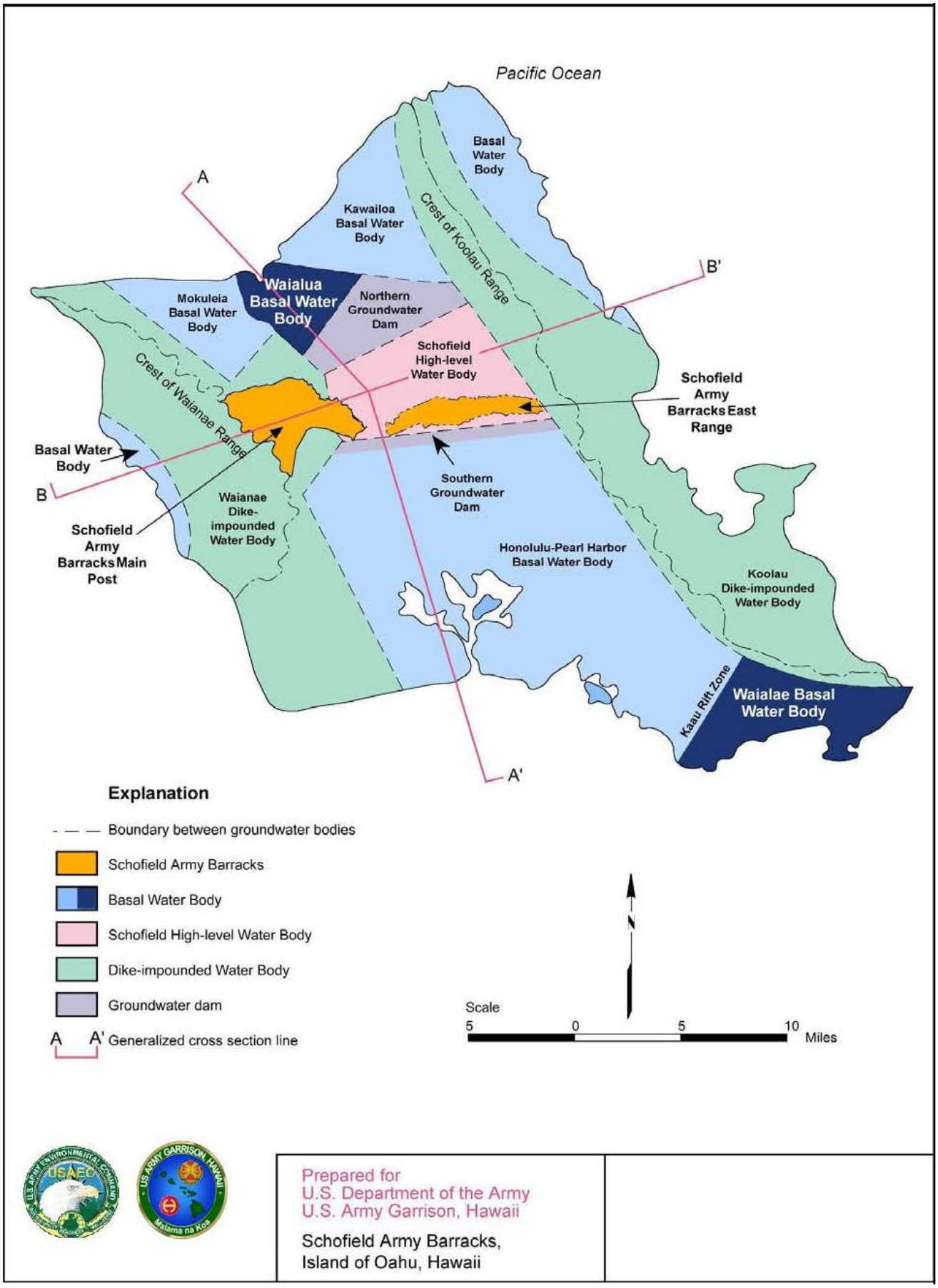

Figure 3. Regional Groundwater Systems of Oahu, Hawaii

Figure source: AEC and DPW, 2012

3.3. History of Contamination

The former landfill (OU 4) was an open burn dump from approximately 1942 until 1967, when it was converted to a sanitary landfill in response to provisions of the Clean Air Act (Ecology and Environment, Inc., 1981; Kennedy Engineers, 1980). The former landfill was used to dispose of a wide variety of solid wastes from various military installations, of which the major contributors were Schofield Barracks, Wheeler Air Force Base (currently Wheeler Army Airfield), and the Wahiawa Radio Station (U.S. Army Support Command, Hawaii, 1983; Kennedy Engineers, 1980). Most of the waste deposited in the landfill was domestic refuse from the surrounding base housing (Ecology and Environment, Inc., 1981); however, wastes were also disposed from various industrial operations (e.g., vehicle and equipment maintenance and construction). Tripler Army Medical Center reportedly contributed medical wastes including pathogenic, infectious, and pharmaceutical (expired and unusable drugs) wastes.

Other materials reportedly disposed in the former landfill were organic solvents, sewage sludge, asbestos, pesticide containers, unusable paints, metallic debris, vegetation, and tree stumps (Environmental Science and Engineering, 1984). Hazardous materials, including live munitions, acids, and solvents, were also reported to have been dumped in the landfill. No records were available concerning the types, amounts, or volumes of wastes disposed at the former landfill, but the rate has been estimated at 100 tons per day. (Kennedy Engineers, 1980)

In April 1985, TCE was detected in groundwater from the Schofield Barracks water-supply wells. The source of the TCE contamination could not be identified; however, it was assumed that TCE likely originally migrated from one or more surface locations through the soil and bedrock to the underlying groundwater.

3.4. Initial Response

Landfill operations ceased on December 31, 1981, prior to the discovery of TCE in the water supply wells. Closure was completed by the end of 1983. The landfill surface was graded and covered with a layer of compacted soil, but the closure plan did not include installation of monitoring wells or a leachate collection system. The landfill was to be periodically monitored and inspected for any deficiencies, and corrective actions were to be initiated if necessary. However, by 1996 (the time of signing of the OU 4 ROD), there were no records of monitoring and inspections, and landfill subsidence had resulted in numerous cracks and the deterioration of the landfill cap.

In May 1985, one month after the detection of TCE in the water supply wells, Schofield Barracks issued a press release regarding the detection of TCE and the temporary switch to city and county water supplies. In September 1986, USAG-HI installed an air stripping treatment unit (the Schofield Barracks water treatment plant [WTP]) to remove TCE and carbon tetrachloride. In 1987, EPA established a maximum contaminant level (MCL) for TCE of 5 micrograms per liter (μg/L) in drinking water. As a result of the detection of TCE in the water supply wells, the Schofield Barracks was placed on the NPL in August 1990.

3.5. Basis for Taking Action

3.5.1. OU 2 Groundwater

During the remedial investigation/feasibility study (RI/FS) for OU 2, groundwater at the Schofield Barracks was determined to be contaminated with TCE and carbon tetrachloride. Antimony and manganese were also detected at levels above their respective MCLs, but because these detections were inconsistent, they were not retained as contaminants of concern (COCs). Carbon tetrachloride, antimony, and manganese detections were limited to groundwater below the former landfill area, while TCE was detected below the former landfill and beneath the East Range and Wheeler Army Airfield area (see Figure 2).

Carbon tetrachloride contamination in groundwater is generally limited to the area beneath the landfill, which is considered the likely source. TCE contamination is generally located in the central and western portions of the Schofield Barracks (near supply wells and the landfill). TCE was also found south of the Schofield Barracks, which likely resulted from migration from the primary contamination beneath the Barracks. Figure 5 shows the approximate location of the TCE plumes and the concentration of TCE from the 2014 and 2015 sampling event. The plume location is generalized due to the complex hydrogeologic conditions.

The risk assessment for OU 2 evaluated domestic use of the untreated groundwater water by adults and children. The non-cancer hazard indices for both children and adults exceeded EPA's benchmark hazard index[2] of 1.0; however, most of this risk was due to the inconsistent detections of antimony near the former landfill. Because of the inconsistencies, and the fact that exposure to groundwater from this area is limited, the elevated hazard indices were not considered significant. All of the carcinogenic risks were below or within EPA's acceptable risk range of 10^{-6} to 10^{-4}. No ecological risk, including from potential irrigation use of the groundwater, was found.

Although the OU 2 ROD does not explicitly describe the basis for taking action, the ROD makes clear that the actual or threatened releases of hazardous substances from the site, as reflected in concentrations of TCE and carbon tetrachloride above their respective MCLs, presented an imminent and substantial endangerment to public health, welfare, and the environment.

3.5.2. OU 4 Landfill

During the RI/FS for OU 4, it was determined that soil gas, subsurface soil, and groundwater had been impacted by the former landfill, primarily by volatile organic compounds, including TCE. The risk assessment identified three potential receptor populations: remedial workers, recreational users, and military personnel involved in field exercises. None of the non-cancer hazard indices exceeded EPA's benchmark hazard index of 1.0, and the maximum total carcinogenic risk was within EPA's acceptable risk range of 10^{-6} to 10^{-4}. No ecological risk was found.

[2] A hazard index is the sum of hazard quotients for individual contaminants that have similar effects on the same target organ.

Although the OU 4 ROD does not explicitly describe the basis for taking action, the ROD makes clear that the presence of hazardous substances (i.e., landfill contents) on site exceeding health-based levels presented a current or potential threat to public health, welfare, or the environment.

4. Remedial Actions

4.1. OU 2 Groundwater

4.1.1. Remedial Action Objectives

The site COCs are TCE and carbon tetrachloride with the remediation goals as shown in Table 2.

Table 2. OU 2 Groundwater Remediation Goals

Contaminant of Concern[1]	Cleanup Level[2]	Basis for Remediation Goal
Trichloroethylene (TCE)	5 µg/L	EPA MCL
Carbon Tetrachloride	5 µg/L	EPA MCL

Notes:
1 – Table 2.3 in the ROD (HLA, 1997) also established standards for other organic chemicals detected in the groundwater that apply to cleanup of extracted groundwater. These standards would apply 'at the tap' based on the determination that the underground water system at Schofield Barracks is a public water system.
2 – Table 2.3 in the ROD incorrectly identified the units as mg/L. The basis for the cleanup level was the MCL, given in units of µg/L.
MCL = maximum contaminant level

The remedial action objectives (RAOs) for OU 2 as identified in the feasibility study (HLA, 1996a) were as follows:

- Mitigate the risk to human health and the environment from potential exposure to contaminated groundwater
- Satisfy state and federal applicable or relevant and appropriate requirements (ARARs)

4.1.2. Remedy Description

The ROD for OU 2 was issued on 7 February 1997 (HLA, 1997). The following remedy components were identified in the 1997 ROD:

- Continued treatment for COCs present in extracted groundwater at the Schofield Barracks Supply Wells by air stripping at the wellhead followed by discharge of the treated water to the distribution system
- USAG-HI consultation with EPA and State of Hawaii Department of Health prior to abandoning the Schofield Barracks water supply wells because production at these wells may help to control plume migration
- Long-term sampling and analysis of water supply wells, agricultural wells, and monitoring wells in the region

- Implementation of the contingency of wellhead treatment on any water supply wells that are impacted by the plume from Schofield Barracks above one-half the MCL as established under the Safe Drinking Water Act
- Upgrades to the treatment system or payment of any incremental costs caused by contamination from Schofield Barracks at wells that already have a treatment system in place
- Conducting FYRs with the State of Hawaii and EPA

Additionally, any new public or private wells installed within the area covered by the long-term monitoring network were to be added to the existing long-term monitoring network. Should these wells become contaminated with COCs directly attributable to Schofield Barracks, the selected wellhead treatment was to be implemented at these wells.

The remedy chosen only addressed contamination in the drinking water supply. It was determined, based on complex hydrogeologic conditions, that restoration of groundwater was impractical. Therefore, EPA granted a technical impracticability (TI) waiver for restoration of groundwater to the MCL through approval and signature of the ROD. EPA's TI waiver justification was included as an attachment to the ROD, which was dated 7 February 1997.

4.1.3. Remedy Implementation

The OU 2 selected remedy was implemented immediately following issuance of the OU 2 ROD through continued wellhead treatment at the already operating Schofield Barracks WTP. The WTP was designed to remove TCE. It consists of five packed air stripping towers, but at any given time only four are in operation while the fifth is being cleaned. Other system components include four extraction wells, a chlorination system, a fluorination system, process pumps, and groundwater extraction pumps.

Upon signing of the OU 2 ROD, the Kunia Village air stripper treatment system (ASTS) that was already operating was brought into USAG-HI's OU 2 management purview in accordance with the selected remedy, which required any wells impacted by the Schofield plume to receive wellhead treatment. USAG-HI reimbursed Del Monte for the capital cost of the air stripping system and began reimbursement for operation and maintenance costs. The Kunia Village ASTS was designed to remove TCE and carbon tetrachloride. It consists of one air stripping tower, one process pump, and one groundwater extraction well with one extraction pump.

In 2005, an exploratory well was drilled at the Sandwich Isles Communication Field Site Waipio Acres (Sandwich Isles) to serve as irrigation for the site. Laboratory tests showed levels of TCE exceeding the MCL. In accordance with the OU 2 ROD, USAG-HI agreed to implement contingency wellhead treatment because contamination was directly attributable to Schofield Barracks. Groundwater was to be treated to a level below one-half the MCL for TCE. In September 2011, the Sandwich Isles ASTS was installed and began operating on 17 February 2012. It consisted of two air stripping towers, a chlorine disinfection unit, a granular activated carbon air scrubber, a deep well pump, and a water storage tank. By 2014, limited development had occurred at the Sandwich Isles site, and the need for treated groundwater had yet to be realized. Due to the limited need for treated groundwater, the ASTS ceased operation in 2014. Currently, in 2017, the need for treated groundwater

is once again being expected in the near future. USAG-HI is currently developing plans to place the Sandwich Isles ASTS back into operation.

In 2015, a private land owner drilled a well at the Villa Rose site to use groundwater for irrigation purposes. Laboratory tests showed elevated TCE concentrations, and USAG-HI agreed to implement a wellhead treatment at this site. USAG-HI is currently in the process of installing a carbon filtration system for treatment.

4.1.4. Systems Operations & Maintenance

An interim long-term monitoring program was conducted from September 1996 through January 1997. The long-term monitoring program for OU 2 was implemented in April 1997 and continues to the present. The components of the OU 2 remedy during the last five years included the following:

- Long-term groundwater monitoring program implementation
- Schofield Barracks WTP operation and maintenance (O&M)
- Kunia Village ASTS O&M
- Sandwich Isles ASTS O&M

CAPE Environmental Management, Inc. (CAPE), a contractor to USAG-HI, samples the wells listed in long-term monitoring plans (Final O&M plans) for OUs 2 and 4 (HLA, 1996c; HLA, 1996d), and prepares semi-annual and annual monitoring reports. If contaminant concentrations exceed threshold values listed in the Final O&M plans, then sampling is increased at the wells. Each year, CAPE also reviews the State of Hawaii's records on new groundwater wells installed and evaluates them for inclusion into the monitoring network.

The trigger concentration for increasing sampling frequency at wells that were previously uncontaminated is 0.3 µg/L. If the well is used for domestic water supply purposes, the well must then be evaluated for wellhead treatment. In this scenario, the well is then sampled quarterly until the concentration drops below the 0.3 µg/L or treatment begins. However, if the well is for irrigation, industrial use, or a monitoring well, it will continue to be sampled semi-annually.

For the Schofield Barracks WTP, O&M is performed by Schofield Barracks personnel and primarily consists of replacement of bag filters every two weeks, wash down of one packed air stripper tower weekly, replacement of flow meters and flow sensors, as needed, and quarterly influent and effluent water sampling. Costs associated with regular O&M for the WTP are about $4,000 per year. In 2013 and 2014, the air stripper towers were repainted and the anchor brackets were replaced, costing about $57,000.

For the Kunia ASTS, O&M is performed by CAPE. Costs associated with the Kunia ASTS are paid for, or reimbursed, by USAG-HI. The costs paid for to-date are for air stripper tower installation, blower replacement, and routine O&M such as cleaning the blower intake screen and removing sand from the stripper tower floor. CAPE inspects the ASTS quarterly and provides O&M reports to USAG-HI. During the last five years, specific maintenance was conducted to repair a water control valve, replace a broken wire that had caused an electrical system failure, repair a broken gasket on the blower, replace blower driver belts several times, caulk a leak in the treated water fiberglass piping,

replace the emergency generator battery, and remove a bee's nest from the control panel. In May 2012, a warning beacon was installed to indicate to nearby residents that the ASTS was in operation. Operation and maintenance costs for the Kunia ASTS were not available at the time of preparing this FYR.

For the Sandwich Isles ASTS, while it was in operation, O&M was performed by GreenWave Solutions, Inc., a contractor to USAG-HI. Regular maintenance consisted of replacing hoses and loose wiring, cleaning packed bed material, removing sediment at the bottom of the towers, and collecting pre- and post-treatment water samples. During the first four months of operation, the two towers were found to be operating at different removal efficiencies. Investigations found that media in one tower had settled significantly, and so additional packing media was ordered and added to each tower as needed. During the third quarter of 2012 (the third quarter it was in operation), there was reduced need for the ASTS, so it was recommended that only one tower should operate at a time at 1 hour per day, alternating quarterly, and that if the system should sit idle for more than a week, the full system should be cleaned with chlorine. In 2014, the Sandwich Isles ASTS was taken out of service due to lack of need for treated groundwater. Costs for operating the ASTS were not available.

4.2. OU 4 Landfill

The ROD for OU 4 was signed on 26 September 1996 (HLA, 1996b).

4.2.1. Remedial Action Objectives

Remedial objectives were not defined in the OU 4 ROD. However, the ROD stated the selected remedy was consistent with EPA's Presumptive Remedy for CERCLA Municipal Landfill Sites (EPA, 1993), which contains the following objectives that are applicable to the remedy for OU 4:

- Prevent direct contact with landfill contents
- Reduce contaminant transport to groundwater
- Control surface water runoff and erosion
- Control landfill gas

4.2.2. Remedy Description

The remedy components identified in the ROD were as follows:

- Regrade existing landfill cover to generally match the 1983 engineered drainage grade
- Perform long-term maintenance of the landfill cover
- Maintain existing passive landfill gas venting
- Install additional gas monitoring points at the perimeter of the landfill
- Institutional controls to include long-term groundwater monitoring, five-year site reviews, and access restriction and site security
- Remove Guinea grass from the existing cover and revegetate

4.2.3. Remedy Implementation

Implementation of the remedy began on 10 March 1997 and occurred in several different construction phases. The final inspection was performed on 21 July 1998. Remedial activities consisted of the following:

- Clearing and grubbing of existing vegetation and selected trees and shrubbery
- Repairing landfill cracks
- Filling of landfill subsidence areas
- Regrading the surface of the landfill cover to maintain a positive slope to promote surface water runoff
- Landscaping with new vegetation
- Repairing a portion of the existing central drainage system
- Repairing eroded areas on the sides of the existing central drainage system
- Installing a cement rubble masonry channel
- Installing nine new gas monitoring wells and modifying five existing monitoring wells

Upon completion of remedial activities, EPA determined that the landfill cap, drainage, and monitoring systems were complete, functional, and operational. The main features of the landfill cap are shown on Figure 4.

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Schofield Landfill Overview Map

Legend

Irrigation System
- Sprinkler Head Location
- Fire Hydrant
- Smartlink Control Box

Facility Access Control System
- Site Access Gate
- Security Fence

Runon/Runoff Controls
- Center Drainage Channel
- North-central Side Slope Drainage Chute
- Northern Drainage Channel
- Northern Runoff Control Berms
- Northern Side Slope Drainage Chute
- Northwestern Side Slope Drainage Chute
- Western Drainage Channel

Monitoring Points
- Gas Monitoring Points
- Monitoring Wells

N

0 200 400 Feet

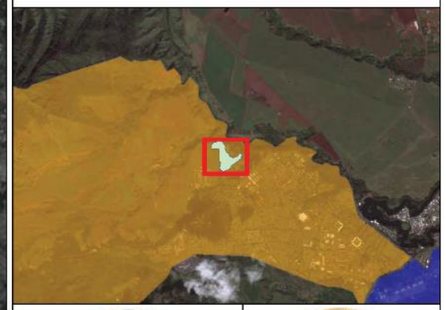

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Figure 4. OU 4 Landfill Map
Figure source: AEC and DPW, 2016

4.2.4. Operations & Maintenance

O&M for OU 4 consists of visual quarterly inspections of the following landfill components:

- Facility access control system
- Run-on and surface drainage systems
- Final landfill vegetative cover
- Groundwater monitoring wells
- Gas monitoring systems
- Side slopes
- Security fencing
- Access roads

The OU 4 O&M Plan also requires additional inspections of the landfill cover, side slopes, and drainage system after heavy rainfall events and after major storm or earthquake events. Any damaged perimeter landfill gas monitoring wells, existing landfill gas wells, and groundwater monitoring wells are required to be repaired or replaced accordingly. In addition, any damaged security fences, access roads, and survey monuments are required to be repaired immediately.

Long-term monitoring for OU 4 originally included monitoring the lower explosive limit of landfill gas at boundary wells, but since this requirement was met for several years, the second FYR proposed discontinuing landfill gas monitoring (ECC and MACTEC, 2007). EPA and the Hawaii Department of Health agreed, and landfill gas monitoring ceased in 2007. In 2008, extensive damaged occurred to the central drainage channel during a heavy rainfall. The cap of the landfill was not directly impacted by this damage. Repairs to the drainage channel were completed in 2010. In July 2008, soil moisture probes were installed to help manage the irrigation system and ensure that it was not causing excessive infiltration through the cap. In 2013, after five years of data indicated that the irrigation system did not cause excessive infiltration, the consultant at the time recommended that that moisture monitoring cease. In April and May 2015, during installation of a new irrigation system, the soil moisture monitoring probes were removed.

O&M costs for the OU 4 remedy generally included landfill gas monitoring (now discontinued), landfill landscaping (re-grading, application of herbicide to remove Guinea grass, etc.), landfill cover crack repair (from settlement and desiccation), and repair/replacement of any other damaged components listed above. In the past five years, O&M costs for OU 4 were divided among several contracts that also covered many other sites within the purview of the Directorate of Public Works (DPW) at Schofield Barracks. For this reason, costs specific to OU 4 could not be easily identified for this evaluation. During interviews (Section 6.6), DPW staff and O&M managers indicated that maintenance of OU 4 was minimal and costs were reduced in 2014 due to a reduction in reporting frequency.

Quarterly inspections were completed regularly during the past five years. Common issues identified include barren areas (no vegetation), excessive vegetation growth in other areas, damaged geo-fabric at the drainage channels, tree branches fallen on fencing, and well casings that needed painting. A

crack in the landfill cap was identified once, during the July 2012 inspection. Corrective actions for all issues identified were addressed promptly, often within one month.

4.3. NPL Status

In August 2000, following the remedial actions described above, Schofield Barracks was deleted from the NPL.

5. Progress since the Last Five-Year Review

5.1. OU 2 Groundwater

5.1.1. Protectiveness Statement from Last Review

The protectiveness statement for OU 2 from the 2012 FYR stated the following:

> The remedy at OU 2 is expected to be protective of human health and the environment and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

5.1.2. Status of Recommendations and Follow-up Actions from Last Review

Three issues for OU 2 was identified in the 2012 FYR. Only one issue was identified which affects protectiveness and is summarized in Table 3. This action was completed in October 2015.

Table 3. Status of Recommendations for OU 2 from the Last Five-Year Review

Issues from Previous Review	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
One new irrigation well has been placed inside the plume boundary and three wells have been placed outside the plume boundary but within the extended monitoring well boundary.	Evaluate the wells for inclusion in the monitoring well network and improve the implementation of the ICs with better coordination with the State of Hawaii water well permitting program.	Federal Facility	31 December 2012	Only two of the identified wells continue to be in operation. Samples were taken in October 2015. The 2015 annual monitoring report recommended only one well be included in the monitoring network.	October 2015

Two additional issues were identified which did not affect protectiveness. These issues and their current status are:

- Three other new wells (3-3001-01, 3-3104-02, and 3-3104-03) have been installed in the monitoring network area. These wells should be evaluated to see if they are appropriate for addition to the monitoring network.
    - Well 3-3001-01 was sampled in September 2015. Based on the results it was not recommended for inclusion in the monitoring program. (AEC and DPW, 2016)
    - Well 3-3104-02 were sampled in September 2015. Based on the results it was recommended for inclusion in the monitoring program. (AEC and DPW, 2016)
    - Well 3-3104-03 had not actually been installed as of January 2016. It will be evaluated during a future long-term monitoring report after installation is complete. (AEC and DPW, 2016)
- Additional coordination between USAG-HI, Hawaii Department of Land and Natural Resources, and Hawaii Department of Health should be implemented to assure that no domestic wells are installed and put into use that may allow human exposure to TCE-contaminated water.
    - CAPE, a contractor to USAG-HI, coordinates with the Department of Land and Natural Resources and the Department of Health to complete an annual evaluation of new wells installed in the area. This evaluation reviews groundwater concentrations and recommends if new wells should be included in the long-term monitoring network. Results are presented in the annual long-term monitoring report.

5.2. OU 4 Landfill

5.2.1. Protectiveness Statement from Last Review

The protectiveness statement for OU 4 from the 2012 FYR stated the following:

> The remedy at OU 4 is expected to be protective of human health and the environment and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

5.2.2. Status of Recommendations and Follow-up Actions from Last Review

No issues affecting protectiveness were identified for OU 4 in the 2012 FYR.

6. Five-Year Review Process

6.1. Administrative Components

USAG-HI initiated the FYR in June 2016 and scheduled its completion for September 2017. The review team included Kayla Patten, environmental engineer; and Jeff Weiss, geologist; all with the USACE Seattle District.

6.2. Community Involvement

A Community Involvement Plan for Schofield Barracks was finalized in February 2014. The plan described options for community involvement activities, which included fact sheets, public notices, and public meetings.

A public notice was issued in the Honolulu Star Advertiser on 11 January 2017, stating that USAG-HI was initiating the FYR for OUs 2 and 4. Contact information was provided for the public to submit comments. No public comments were received.

6.3. Document Review

This FYR consisted of a review of relevant documents, including past investigations, groundwater monitoring data, and treatment plant data. Applicable groundwater MCLs and cleanup standards were reviewed, as well as current cleanup standards and guidance associated with TCE and carbon tetrachloride. Documents reviewed for this FYR are listed in Section 12.

6.4. Site Inspection

6.4.1. OU 2 Groundwater

The site inspection for OU 2 occurred on 18 January 2017. The treatment systems at the Schofield Barracks WTP and the Kunia Village ASTS were also inspected. At the Schofield Barracks WTP the piping and air stripping towers were found to be in good condition with some minor leaks. Extraction pumps were not observed due to access limitations into the tunnel where they are located. Overall, no issues were discovered.

The Kunia Village ASTS was not in operation at the time of the inspection because the extraction pumps, which are maintained by Kunia Village, were broken and not providing water to the treatment system. A visual inspection of fencing and other equipment was conducted. All equipment appeared to be in adequate condition. The treatment plant is maintained in operational condition if the extraction pumps were to be placed back online.

6.4.2. OU 4 Landfill

A site inspection for OU 4 occurred on 18 January 2017. The OU 4 landfill inspection observed the landfill cap, the state of the vegetation, the fencing, the drainage controls, and the signage. The inspection found no physical issues with the landfill. A site inspection report and checklist are available in Appendix C.

6.5. Data Review

6.5.1. OU 2 Groundwater

Groundwater

Groundwater quality data collected between October 2010 and September 2015 was reviewed for this FYR. The FYR covers the time period from 2012 to 2017; however, analytical data were only available through the end of 2015. The analytical data are provided in annual monitoring reports.

The objectives of the remedy for the site includes protection of human health and the environment from exposure to contamination, which is achieved through treatment of contaminated groundwater prior to use as drinking water and through monitoring of contaminants in water wells. Due to complex hydrogeologic conditions, EPA issued a TI waiver stating that groundwater does not need to be restored to the MCLs.

Table 4 summarizes the groundwater sampling results for TCE and carbon tetrachloride between October 2010 and October 2015. Figure 5 shows the locations of the monitored wells, concentration of TCE measured between 2014 and 2015, and plume map of the TCE. Figure 5 labels the wells with either the state well ID or the well name used for monitoring. Table 4 lists both the state well ID and the well name. Carbon tetrachloride was detected in 23 out of the 33 wells sampled at concentrations between 0.04 and 4.2 µg/L, which are below the MCL of 5 µg/L. The highest concentrations were detected near the landfill (OU 4). TCE was detected in 26 out 33 wells at concentrations between 0.05 and 70 µg/L, with 13 of them exceeding the MCL of 5 µg/L. Well 3-2603-01 (Hawaii Country Club), had a detection of 0.05 µg/L of TCE in October 2015 which is below the limit of quantitation and above the method detection limit so the value is an estimate. The highest concentrations of TCE were detected at the Schofield supply wells and the landfill.

A trend analysis was completed using contaminant concentrations over the previous five years to evaluate if contamination is migrating towards clean areas. The trend analysis was completed using the Mann-Kendall method on the data collected between 2010 and 2015. Appendix E presents the results of the Mann-Kendall analysis. The trend analysis was only completed for locations where more than four samples had detections within the past five years. At the ten wells where the trend analysis was completed for carbon tetrachloride, all of the trends were either decreasing or stable. Out of the 17 wells where the trend analysis was completed for TCE, five were increasing, four were stable, and eight had no trend. The location of the wells with increasing and decreasing concentrations does not indicate a general trend in contaminant migration across the site. The complex hydrogeology and depth to water prevent a more extensive site characterization necessary to evaluate the contaminate migration.

Samples collected from down-gradient wells to the north and south of Schofield Barracks have all been non-detect for carbon tetrachloride and TCE, except Well 3-2603-01 (Hawaii Country Club), which had a detection of 0.05 µg/L of TCE in October 2015, but it is noted that this was a "J-flagged" estimated value. J-flagged values are detected above the method detection limit, but below the limit of quantitation and are therefore estimated.

Schofield Barracks Water Treatment Plant

The Schofield Barracks WTP was in operation for the duration of the review period. The two COCs for the air stripper effluent are carbon tetrachloride and TCE. Samples of the effluent were taken quarterly. All samples of carbon tetrachloride were non-detect (below the detection limit of 0.2 or 0.5 µg/L, depending on the date). The majority of TCE samples were below the 0.5 µg/L non-quantifiable limit. The highest concentration of TCE recorded in the last five years was 1.0 µg/L on 13 July 2016.

Kunia Village Air Stripper Treatment System

The Kunia Village ASTS data extend from previous review to the 7 March 2016 sampling event. Effluent samples were taken quarterly and COCs were TCE and carbon tetrachloride. The effluent was found to be well below the 5 µg/L MCL, and the vast majority of the samples were non-detect. The highest level recorded was 0.12 µg/L, but this was a "J-flagged" estimated value.

Sandwich Isles Air Stripper Treatment System

The Sandwich Isles ASTS operated from February 2012 through early 2014. Due to the ongoing O&M changes described in Section 4.1.4, effluent was inconsistently sampled during this period. Sampling data were available primarily for 2012; only limited sampling data were available for 2013 and 2014. Effluent was sampled for TCE only, and the samples were all found to be below the MCL for TCE. The highest concentration detected was 3.5 µg/L in September 2012.

Perfluorinated Compound Sampling Results

In 2014, two sampling events occurred to collect groundwater samples at Schofield Barracks for the purpose of analyzing the samples for concentrations of perfluorooctanoic acid, perfluorononanoic acid, perfluorooctanesulfonic acid, perfluoroheptanoic acid and perfluorohexane sulfonic acid. These sampling events occurred on 19 March 2014 and on the 9 September 2014. The analytical method used was EPA 537. The results indicated that perfluorinated compounds listed above were below levels of detection and would therefore not impact the protectiveness of the remedy on base. The data retrieved indicates that the sampling point for these samples were at the Building 1575 Post Chlorination. Groundwater was the identified source of the water.

Table 4. Summary of Groundwater Sampling Results October 2010 to October 2015

State Permit Well Number	Well Name	Type of Well[2]	Number of Samples	Carbon Tetrachloride[1]			Trichloroethylene (TCE)[1]		
				Max. Conc. (µg/L)	Min. Conc. (µg/L)	Mann-Kendall Trend Analysis[3]	Max. Conc. (µg/L)	Min. Conc. (µg/L)	Mann-Kendall Trend Analysis[3]
3-2600-03	Mililani III Well # 2 (BWS Unit #8)	Offsite Production or Irrigation Well	4	ND	ND		ND	ND	
3-2603-01	Hawaii Country Club	Offsite Production or Irrigation Well	5	ND	ND		0.05	0.05	
3-2702-05	Waikakalaua # 5	Offsite Monitoring Well	4	0.35	0.26	No Trend	**6.1**	3	Increasing
3-2703-02	"Basal Well" (aka New M.W.)	Offsite Production or Irrigation Well	2	ND	ND		0.59	0.41	
3-2800-03/01	Mililani I Well # 3 (BWS Unit #3)	Offsite Water Supply Well	2	ND	ND		0.46	0.46	
3-2801-02	MW-2-4	Onsite Monitoring Well	6	0.04	0.04		**28**	**14**	Increasing
3-2802-01	MW-2-6	Onsite Monitoring Well	4	1.2	0.48	Stable	3.5	1.8	Stable
3-2803-01	Navy Kunia	Offsite Production or Irrigation Well	7	0.93	0.53	Stable	4	0.34	No Trend
3-2803-05	Kunia Battery (Pump # 3)	Offsite Production or Irrigation Well	17	1.2	0.7	Stable	**5.6**	3.9	No Trend
3-2803-07	Kunia (Pump # 4)	Offsite Production or Irrigation Well	6	0.99	0.22	No Trend	4.7	1.5	No Trend
3-2900-02	MW-2-1	Onsite Monitoring Well	4	0.04	0.04		**43**	**33**	No Trend
3-2901-01	Schofield Shaft Monitoring Well	Onsite Monitoring Well	3	0.05	0.05		1.7	0.41	
3-2901-02	Schofield Supply Well #1	Onsite Drinking Water Supply Well	8	ND	ND		**29**	**12**	No Trend
3-2901-03	Schofield Supply Well #2	Onsite Drinking Water Supply Well	4	0.07	0.07		**16**	**8.8**	No Trend
3-2901-04	Schofield Supply Well #3	Onsite Drinking Water Supply Well	6	ND	ND		**29**	**15**	Stable
3-2901-10	Schofield Supply Well #4	Onsite Drinking Water Supply Well	14	0.5	0.5		**70**	**33**	No Trend
3-2901-11/08	Wahiawa I Well # 12 (BWS Unit #1)	Offsite Production or Irrigation Well	2	0.17	0.17		0.27	0.16	
3-2901-12	Wahiawa I Well # 2	Offsite Production or Irrigation Well	5	0.27	0.18	Stable	0.19	0.19	
3-2901-13	MW-1-1	Onsite Monitoring Well	8	0.1	0.1		**17**	2.5	Probably Increasing
3-2902-01	Wahiawa II Well # 1 (BWS Unit #1)	Offsite Water Supply Well	1	0.27	0.27		ND	ND	

Table 4. Summary of Groundwater Sampling Results October 2010 to October 2015 (continued)

State Permit Well Number	Well Name	Type of Well[2]	Number of Samples	Carbon Tetrachloride[1]			Trichloroethylene (TCE)[1]		
				Max. Conc. (µg/L)	Min. Conc. (µg/L)	Mann-Kendall Trend Analysis[3]	Max. Conc. (µg/L)	Min. Conc. (µg/L)	Mann-Kendall Trend Analysis[3]
3-2902-03	MW-2-3	Onsite Monitoring Well	5	1.4	0.67	Stable	**5.3**	2.1	Stable
3-2903-01	MW-2-2	Onsite Monitoring Well	4	0.08	0.08		1.1	0.84	No Trend
3-2959-01	MW-2-5		3	ND	ND		0.64	0.62	
3-3001-01 (4)	Ali Turf	Offsite Production or Irrigation Well	1	0.05	0.05		ND	ND	
3-3004-01	MW-4-1	Onsite Monitoring Well	2	3.5	2.6		**23**	**17**	
3-3004-03	MW-4-3	Onsite Monitoring Well	7	3.2	2	No Trend	**26**	**18**	Increasing
3-3004-04	MW-4-4	Onsite Monitoring Well	8	4.2	2.9	No Trend	**33**	**22**	Probably Increasing
3-3004-05	MW-4-2A	Onsite Monitoring Well	4	0.39	0.28	No Trend	1.9	1.5	Stable
3-3100-02	NCTAMS EASTPAC	Offsite Production or Irrigation Well	5	0.04	0.04		ND	ND	
3-3102-02	Pump # 24	Offsite Production or Irrigation Well	4	ND	ND		ND	ND	
3-3103-01	Pump # 5	Offsite Production or Irrigation Well	2	ND	ND		ND	ND	
3-3104-02 (4)	HEP	Offsite Production or Irrigation Well	1	0.08	0.08		0.24	0.24	
3-3203-02	Pump # 26 (Waialua Sugar Co.)	Offsite Production or Irrigation Well	5	ND	ND		ND	ND	

Notes:

Bold concentration above maximum contaminant level (MCL)

ND non-detect

1 – Reporting Limit: 0.5 µg/L for both carbon tetrachloride (CCl_4) and TCE

Method Detection Limits:

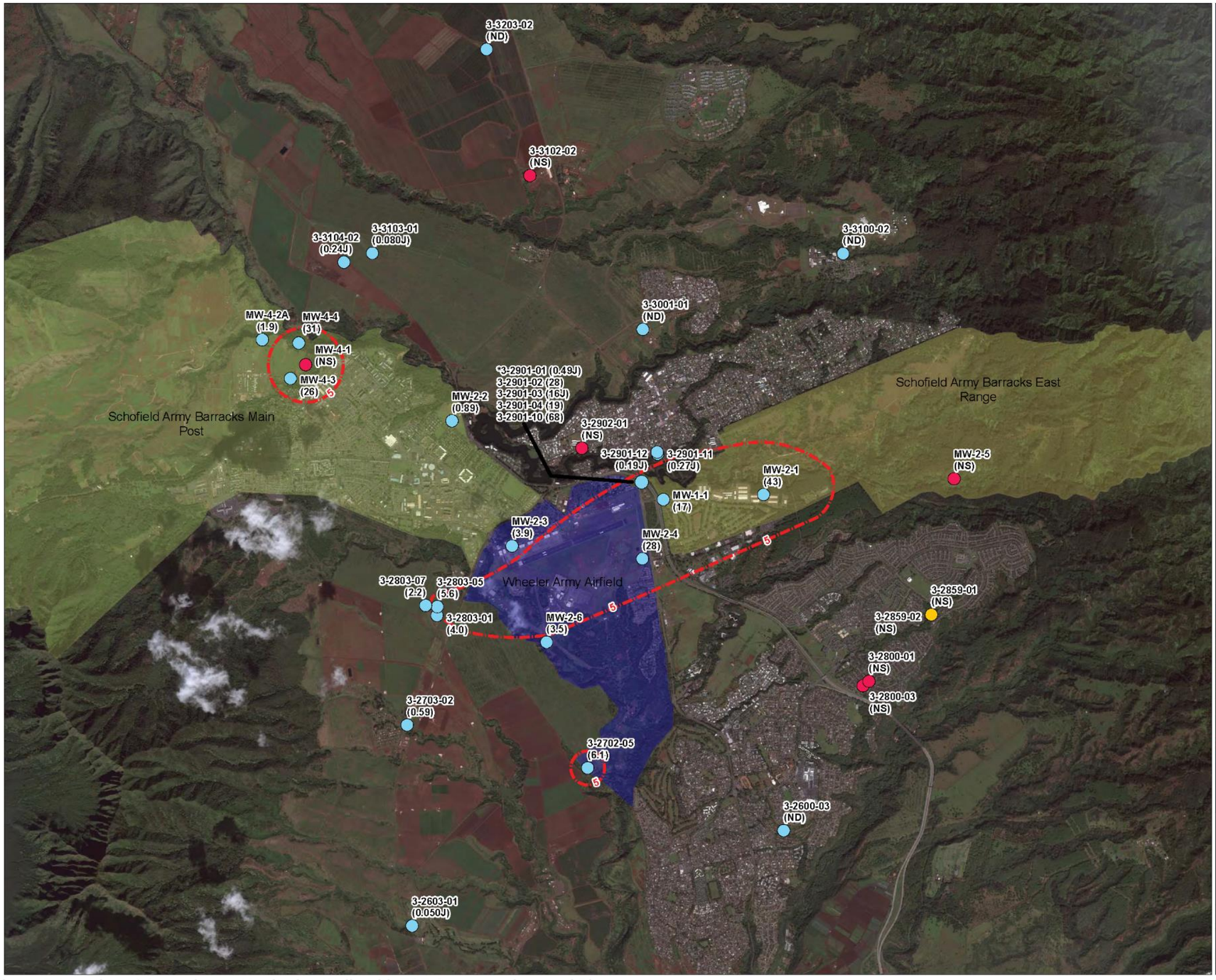
Prior to 2015: CCl_4 = 0.15 µg/L, TCE = 0.15 µg/L

Starting in 2015: CCl_4 = 0.039 µg/L, TCE = 0.027 µg/L

2 – Onsite wells refers to Schofield Barracks and Wheeler Army Airfield

3 – Mann-Kendall analysis was only completed for locations with four or more samples with detections. Mann-Kendall results are shown in Appendix E.

4 – These wells are not included in the long-term monitoring plan. They were sampled during October 2015 to evaluate if they should be included in the long-term monitoring plan.



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Operable Units 2 and 4, Round 76 Trichloroethene Plume Map

Legend

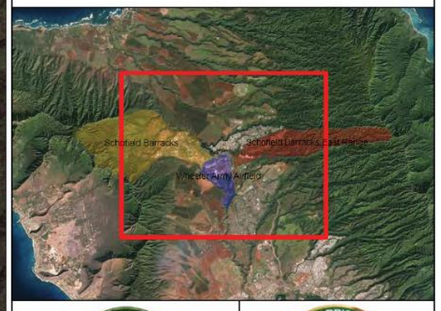
- Rounds 75 & 76 Wells
- Well Sampled Within 2010-2015, But Were Not Sampled in Rounds 75 & 76
- Well Sampled Only Before 2010, No Data in 2010-2015
- 5 Trichloroethene (TCE) Isoconcentration Contour (5 µg/L)
- Schofield Army Barracks
- Schofield Barracks East Range
- Wheeler Army Airfield

Well ID - 3-2901-12
TCE Concentration - (0.19J)
J - Result is an estimate
ND - Non-detect
NS - Not sampled in Round 76

N

NOTES:
1. TCE Isoconcentrations are inferred.
2. * Well not used for contouring.

0 4,000 8,000 Feet



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DATE: JANUARY 2016	

Figure 5. Location of Groundwater Monitoring Wells with TCE Concentrations and Plumes
Figure Source: AEC and DPW, 2016

6.5.2. OU 4 Landfill

The soil moisture monitoring system was installed in 2008 at the landfill, but it was removed during installation of the new irrigation system in 2015, as it had been determined that excessive watering was not occurring at the landfill. Soil moisture data were not independently reviewed, and they will not be part of the ongoing remedy. Groundwater sampling data associated with OU 4 were reviewed as part of the OU 2 data review.

6.6. Interviews

Interviews were conducted with several individuals involved in the OU 2 and 4 remedies: Mark Ripperda, EPA Remedial Project Manager; Troy Rosenbush, CAPE Environmental Management, Inc., manager for OU 2 and 4 long-term monitoring; and Wayde Nakai, USAG-HI DPW, water treatment plant supervisor for the Schofield Barracks WTP. Interview records are included in Appendix B.

All interviewees indicated that the remedies are functioning very well with no issues beyond regular maintenance. Mr. Ripperda indicated that EPA is interested in identifying opportunities to include other uses at the landfill site consistent with the land use restrictions, such as solar energy. Mr. Nakai indicated that the Schofield WTP is operating very well with only regular maintenance required. In the long term, Mr. Nakai is interested in the possibility of moving the extraction wells out of the tunnel they are currently in, and to the ground surface. Currently, maintenance staff must ride a cart down to the tunnel, which can lead to difficulties when the cart is broken. Mr. Rosenbush indicated that in 2014 he reduced quarterly monitoring reporting to semi-annual reporting. This reporting reduction has saved about $20,000/year. He has also seen the number of wells in the groundwater monitoring network decline due to failure, and ultimate removal, of privately owned wells, which he expects to continue into the future. Although these failed private wells are usually removed from the monitoring network permanently, Mr. Rosenbush believes that remaining wells are sufficient to continue to characterize the site. Mr. Rosenbush indicated that his company, CAPE, Inc., conducts an annual review of new wells installed and compares their locations to the known contamination area to determine if the wells should be added to the monitoring well network. This review is based on data provided to them by the State of Hawaii.

7. Technical Assessment

7.1. Question A – Is the remedy functioning as intended by the decision documents?

OU 2 Groundwater

Yes, the elements of the remedy are functioning as intended, since contaminated groundwater is not being utilized as a drinking water source. The Schofield Barracks WTP is operating as designed, and no potential issue were identified. The treatment plant is treating the water to below the MCLs. The Kunia Village ASTS is not currently needed at Kunia Village because the extraction pumps are broken and not providing drinking water. The ASTS remains in operable condition if the pumps were to be

fixed by Kunia Village and placed back online. Currently, clean drinking water is being supplied to Kunia Village from the Schofield Barracks water supply. The Sandwich Isles ASTS is not in operation; however, groundwater is not being utilized as drinking water in that area. Groundwater is being monitored on a regular basis and annual reviews of newly installed wells are being completed.

OU 4 Landfill

Yes, the landfill is functioning as intended, since exposure to contaminated media is not occurring. Annual inspections of the landfill have shown that the landfill cap is in excellent condition. Any damage found during the quarterly inspections is quickly remedied. There are no indications of potential future issues.

7.2. Question B - Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

OU 2 Groundwater

Yes, the exposure assumptions, toxicity data, cleanup levels, and RAOs remain valid. There have been no changes to exposure pathways, and none are expected in the future. EPA has updated the toxicity values for both carbon tetrachloride and TCE, as shown in Table 5, but these changes do not affect the protectiveness of the remedy because the cleanup levels are based on MCLs. EPA considers the MCLs protective for both cancer and non-cancer effects. The MCLs for carbon tetrachloride and TCE, which are used as cleanup levels, have not changed since the ROD (Table A-2). The groundwater treatment plants are currently meeting RAOs, as they are preventing exposure to contaminated groundwater and meeting the MCLs for drinking water. There have been no changes in the standards identified as ARARs in the ROD that that bear on or affect the protectiveness of the remedy (see Appendix A).

Table 5. Changes in Toxicity Values for OU 2 Groundwater

Contaminant	Toxicity Value, unit	Toxicity Values in ROD[a]	Current Toxicity Values[b]	Does Change Indicate Greater Toxicity?
Carbon Tetrachloride	Oral SF, $(mg/kg/day)^{-1}$	1.3×10^{-1}	7.0×10^{-2}	No. Changes in toxicity values indicate less toxicity than previously thought.
	Oral RfD, mg/kg/day	7.0×10^{-4}	4.0×10^{-3}	
	Inhalation SF, $(mg/kg/day)^{-1}$	5.3×10^{-2}	--	
	IUR[c], $(\mu g/m^3)^{-1}$	1.5×10^{-5}	6.0×10^{-6}	
	Inhalation RfC, mg/m^3		1.0×10^{-1}	
Trichloroethylene (TCE)	Oral SF, $(mg/kg/day)^{-1}$	--	4.6×10^{-2}	Toxicity values were not presented in the ROD, so a comparison cannot be made.
	Oral RfD, mg/kg/day	--	5.0×10^{-4}	
	IUR, $(\mu g/m^3)^{-1}$	--	4.1×10^{-6}	
	Inhalation RfC, mg/m^3	--	2.0×10^{-3}	

NOTES:

IUR inhalation unit risk
SF slope factor
RfC reference concentration
RfD reference dose

a – Toxicity values referenced in the ROD can be found in the Feasibility Study (HLA, 1996a), Appendix B Table 4.

b – Carbon tetrachloride toxicity values were most recently updated on 31 March 2010. TCE toxicity values were most recently updated on 28 September 2011.

c – EPA no longer recommends using inhalation slope factors. For comparison with newer IUR values, the inhalation SF in the ROD was converted to IUR with the following formula: IUR $(\mu g/m^3)^{-1}$ = [SF_i $(mg/kg/day)^{-1}$ x 20 m^3/day x 0.001 mg/µg]/70kg.

OU 4 Landfill

Yes, exposure assumptions and RAOs remain valid. The remedy is achieving RAOs; specifically, exposure is not occurring, infiltration and contaminant transport are not occurring (based upon soil moisture probe data), and surface water runoff is well controlled. Toxicity values used in the risk assessment were not stated in the ROD, and the OU 4 RI/FS was not available[3] to determine these values. However, the COCs for OU 4 are the same as OU 2, and it is likely that the same toxicity values were used during the RI/FS. Consequently, the toxicity assessment presented above for OU 2 is also considered appropriate for OU 4. There are no cleanup values for OU 4.

7.3. Question C - Has any other information come to light that could call into question the protectiveness of the remedy?

Groundwater sample analysis in 2014 found no perfluorinated compounds in the groundwater at Schofield Barracks therefore these compounds do not impact the protectiveness of the remedy. No other information has come to light that would call into question the protectiveness of the remedies for OU 2 or OU 4.

[3] Schofield Barracks staff reported that a box of documents had been lost during transit to the site. It is believed the OU 4 RI/FS was among the documents lost.

8. Issues

No issues were identified that affect the protectiveness of the OU 2 and OU 4 remedies.

9. Recommendations and Follow-up Actions

No issues were identified; however, two recommendations are being made which will optimize and improve the reliability of the remedies:

1. Upon construction of well 3-3104-03, evaluate that groundwater data to determine if it should be included in the monitoring network.
2. The Schofield WTP extraction wells are currently located in a tunnel below the facility, which requires a rail-cart to access. Facility staff have expressed interest in moving the extraction wells above ground to improve access and eliminate maintenance needs for the cart. Facility and DPW staff should discuss the feasibility of such an undertaking.

10. Protectiveness Statements

OU 2 Groundwater

The remedy at OU 2 is protective of human health and the environment.

The Schofield WTP is providing clean drinking water to the distribution system, long-term monitoring is being conducted on an annual basis, and contingency wellhead treatment is being implemented where needed. The remedy is achieving the RAOs. Specifically, exposure to contaminated groundwater is being mitigated and ARARs are being met.

OU 4 Landfill

The remedy at OU 4 is protective of human health and the environment.

The landfill cover is in good condition and regularly maintained. The remedy is achieving the RAOs. Specifically, direct contact with landfill contents is not occurring; infiltration and contaminant transport to groundwater are not occurring; surface water runoff is well controlled; and landfill gas has achieved lower explosive limit requirements.

Site-Wide

The remedies at the Schofield Barracks are protective of human health and the environment.

The groundwater treatment plants are providing clean drinking water, as applicable, long-term groundwater monitoring is being conducted, and the landfill cover is in good condition. The RAOs are

being met through implementation of the groundwater treatment, and continued maintenance of the landfill cap.

11. Next Review

The next FYR will be due within five years of the signature date of this FYR.

12. References

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Appendix A ARAR Analysis

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ARARs Analysis

The purpose of the analysis is to identify if there were any Applicable or Relevant and Appropriate Requirement (ARAR) changes that could affect remedy protectiveness. The following tables describe any changes that have occurred to the action-specific, chemical-specific, and location-specific ARARs identified in the Operable Unit (OU) 2 and OU 4 Records of Decision (RODs). Only ARARs that remain applicable to the site and remedies are included. No chemical-specific or location-specific ARARs were identified for OU 4.

The location-specific ARARs for OU 2 that have changed are summarized in Table A-1; however, the changes were minor and do not bear on or affect protectiveness of the remedy. The following location-specific ARARs have not changed since the signing of the ROD:

- HRS §183D-61 *et seq.*

Table A-1. Changes in Location-Specific Requirements, OU 2

Location	ARAR Changed?	Requirement	Prerequisite	Citation
Presence of federal or state endangered or threatened species	Yes, but the revisions do not bear on or affect the protectiveness of the remedy*	The taking of any threatened or endangered species within the state is prohibited.		HRS §195D-4
Presence of endangered or threatened species **-or-** critical habitat of such species as designated in 50 CFR §17, 50 CFR §226	Yes, but the revisions do not bear on or affect the protectiveness of the remedy*	• Actions that jeopardize species/habitat must be avoided or appropriate mitigation measures taken. • Offsite actions that affect species/habitat require consultation with DOI, FWS, NMFS, and/or state agencies, as appropriate, to ensure that proposed actions do not jeopardize the continued existence of the species or adversely modify or destroy critical habitat. • Consultation with the responsible agency is also strongly recommended for onsite actions.	Action that is likely to jeopardize species or destroy or adversely modify critical habitat	Endangered Species Act of 1973 (16 USC 1531 *et seq.*) 50 CFR §402 Fish and Wildlife Coordination Act (16 USC 661 *et seq.*)

CFR – Code of Federal Regulations
DOI – Department of Interior
FWS – U.S. Fish and Wildlife Service
HRS – Hawaii Revised Statutes (in the ROD this is listed as "HC – Hawaii Citation")
NMFS – National Marine Fisheries Service
USC – United States Code

*These ARARs do not impact the protectiveness of the remedy because the potential modifications of these ARARs do not change requirements with regards to how the remedy will or should function. Instead, these noted changes are in essences more to do with administrative requirements outside the scope of the remedy.

The chemical-specific ARARs for OU 2 are the MCLs for carbon tetrachloride and TCE. These have not changed since the signing of the ROD, as shown in Table A-2.

Table A-2. Changes in Chemical-Specific ARARs, OU 2

Contaminant	Media	Cleanup Level[1]	Standard		Citation/Year
Carbon Tetrachloride	Groundwater	5 µg/L	Previous	5 µg/L	40 CFR Part 141 Subpart G, 1994
			New	5 µg/L	40 CFR Part 141 Subpart G, 2017
Trichloroethylene (TCE)	Groundwater	5 µg/L	Previous	5 µg/L	40 CFR Part 141 Subpart G, 1994
			New	5 µg/L	40 CFR Part 141 Subpart G, 2017

1 – Table 2.3 of the ROD shows concentrations as mg/L; this appears to be a typographical error. The cleanup levels have always been implemented consistent with the MCLs, as µg/L. There were no changes to chemical-specific ARARs.

The action-specific ARARs that have changed are summarized in Table A-3; however, the changes were minor and do not affect protectiveness of the remedy. The following action-specific ARARs have not changed since the signing of the ROD:

- **40 CFR, Part 141, (b) and (g)**
- **HAR §11-58.1-17(a)(9)(A)**
- **HAR§11-58.1-17(a)(9)(B)**
- **HAR §11-58.1-16(a)(5)**
- **HAR §11-58.1-16(b)(1)**
- **HAR §11-58.1-16(b)(3)**
- **HAR §11-58.1-16(c)(5)**
- **HAR §11-58.1-16(d)(3)**
- **HAR §11-58.1-16(e)(2)**
- **HAR 11-58.1-17(b)**
- **HAR 11-59-4(f) and (h)**
- **HAR 11-58.1-17**
- **HAR 11-60.1-68**
- **40 CFR 262 and 40 CFR 263**

Table A-3. Changes in Action-Specific Requirements, OU 2

Action	ARAR Changed?	Requirement	Prerequisite	Citation
Air emissions from the air stripper	Yes, but the revisions do not bear on or affect the protectiveness of the remedy*	Administrative and substantive requirements of permit if exemption listed at §11-60.1-62(d)(1) cannot be met. Requirements include the installation of devices for the measurement or analysis of source emissions or ambient concentrations of air pollutants; monitoring; and requirements concerning the use, maintenance, and installation of monitoring equipment.	Exemption under HAR 11-60.1-62(d)(1).	HAR 11-60.1-68

HAR – Hawaii Administrative Rule

*This ARAR does not impact the protectiveness of the remedy because the potential modification of this ARARs does not change requirements with regards to how the remedy will or should function. Instead, these noted changes are in essences more to do with administrative requirements of the air pollution control permit outside the scope of the remedy. In this case, the requirement is for the installation of measurement devices for a source releasing 500 pounds of hazardous waste into the air. This remedy (with the use of a stripping tower and GAC scrubber) would release far below this requirement and therefore would be exempt.

Appendix B Interview Records

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Five-Year Review Interview Record				
Site:	Schofield Barracks, OUs 2 & 4		**EPA ID No:**	HI7210090026
Interview Type: Telephone Date: 1 February 2017 Time: 1300 – 1330				

Interviewers		
Name	**Title**	**Organization**
Kayla Patten	Environmental Engineer	USACE
Jeff Weiss	Geologist	USACE

Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
Mark Ripperda	EPA	Remedial Project Manager	510-260-7979	Ripperda.Mark@epa.gov

Summary of Conversation

1) What is your overall impression of the project?
Since the site was delisted, haven't been involved too much. Just once every five years during the FYR process. Haven't been to the site in recent years. Overall, remedies are going well. Groundwater treatment system is in compliance, no exceedances in water discharged to the drinking water system. Site has a technical impracticability (TI) waiver that precludes treatment of the aquifer. The wells are showing that the plume isn't growing. For the landfill, every couple of years small issues and O&M needs are identified; nothing major.

2) Is the remedy functioning as expected? How well is the remedy performing?
Yes, the air stripper systems are going well. No issues with the landfill cover. About 10 years ago, there was some erosion issues at the landfill.

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?
Only look at data occasionally. Mostly rely on FYR report to report any issues.

4) Is there a continuous O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.
N/A

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
Don't know if any issues with the sites.

6) What are the annual operating costs for your organization's involvement with the site?
N/A

7) Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, please give details.
N/A

8) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
N/A

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
No, haven't identified any so far.

10) Do you have any comments, suggestions, or recommendations regarding the project?
EPA HQ is always looking for ways to better use sites that have land use restrictions, such as landfills. The Army had previously looked into placing solar panels at the site, but later decided not to because they might use the site for training. Would like the FYR team to discuss this again with the Army and document the Army's position in the FYR report. Can provide contacts at EPA if the Army is interested.

The last FYR report will have contacts at the state Department of Health and state water department [Dept. of Land and Water Resources].

Additional Site-Specific Questions

10) What is the process for newly drilled wells to be identified?
Individual will apply for permit with the state. State should be checking if it is within the boundaries of the plume. Would like FYR team to check state records to determine if new wells have been drilled in the area and determine if proper procedures were followed.

11) Does the Army provide you with information you need for the Site?
Yes, communication is going well.

12) Geology at the site is very complicated. Do you have any historical information about groundwater flow?
The RI describes groundwater flow. There are two main sources of water, one from each of the mountain ranges. Water then infiltrates into the fractured basalt. The two water masses meet under the Schofield site. Some flows north, most flows south over the dike impoundment. There were two contaminant sources: the landfill in the west, and another site in the east that wasn't ever identified. The Army did a good faith effort to find the source. Several wells were drilled and lots of surface investigations, but nothing ever identified a specific source. The plume by the landfill is smaller. Because of these complications, EPA issued a TI waiver.

Five-Year Review Interview Record				
Site:	Schofield Barracks, OUs 2 & 4		**EPA ID No:**	HI7210090026
Interview Type: Telephone Date: 3 Feb 2016 Time: 1330 - 1400				

Interviewers		
Name	**Title**	**Organization**
Kayla Patten	Environmental Engineer	USACE
Jeff Weiss	Geologist	USACE

Interviewees				
Name	**Organization**	**Title**	**Telephone**	**Email**
Troy Rosenbush	CAPE Env. Mgmt., Inc.	Regional Manager	808-791-6890	trosenbush@cape-inc.com

Summary of Conversation

Tory is the project manager for long-term monitoring (LTM) task order for both OUs. Mostly just manages sampling team, but has gone out on sampling and inspections before.

1) What is your overall impression of the project?
Overall, remedies are performing fine. Remedies for both OUs have been in place for long time now. They seem to be stable functioning remedies.

2) Is the remedy functioning as expected? How well is the remedy performing?
Yes. Remedies are going well. Have not observed the landfill during a rain event to see runoff, but during inspections look for typical tell-tale signs of erosion, etc. Haven't seen any issues. Have not ever seen anyone trying to gain access to the landfill site.

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?
When data is collected, they do a trend analysis to look for long-term trends and anomalous results. For production (drinking water) wells, also look for increases in concentrations above the threshold limits in the O&M plan. Also look for plume footprint stability. Overall, have seen a stable footprint.

The landfill requires regular mowing; grass is very lush there. The bench requires inspection and minor maintenance. Occasionally find holes in the fabric liner. The sprinkler system is automated and Troy can adjust it remotely. He monitors weather daily and adjusts if needed. There is significant troop training in the adjacent field to the west. Doesn't think this is the main cause of damage to the western fence; it seems mostly caused by rusting. Troop training does include walking/trekking near the fence line.

4) Is there a continuous O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.
Inspections at the landfill are quarterly. Haven't had any issues gaining access.

Groundwater sampling is quarterly overall, but different suite of wells is sampled depending on if that event is a quarterly, semi-annual, or annual event. Have not had any major issues gaining access to wells. Occasionally roads to the remote wells are difficult to traverse (mud, downed trees), but nothing major. Offsite (private, non-Army) wells are not always in operation. Can't collect samples from wells down for maintenance.

Do get depth-to-groundwater on a regular basis. Got a large interface probe from the Army specifically for this purpose. Don't make groundwater contour maps. When they started their contract, they inherited a long established report format which didn't include it. The Army has not specifically requested they be made. Doesn't think they would learn much from a contour map. The

area is very large, wells are spread out. There would have to be a lot of interpolation. The Army does have a groundwater model that they periodically update.

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
Some wells (3 or 4) have shown long term increasing trends for TCE. With agreement from the Army, frequency has increased to quarterly for these wells.

No changes at the landfill. It is very stable.

6) What are the annual operating costs for your organization's involvement with the site?
N/A

7) Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, please give details.
The onsite (Army-owned) wells have down-hole pumps. These were purchased/installed in 1996 and are starting to degrade and fail. Part of contract is to repair and replace as needed. This has not caused any major issue. The groundwater is very deep (500-600 ft) which makes it difficult to pull up the pumps. It is a large effort to replace pumps.

8) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
Because both remedies are so mature, there isn't much optimization to be done. When began contract in 2014, requested to reduce landfill inspection reporting to semi-annual (from quarterly). Inspections are still done quarterly. This saves about $20,000/year.

No optimization is needed for groundwater sampling. All private wells have rights-of-entry agreements in place, but the private owners don't necessarily keep the wells in working condition. Some agricultural wells are not needed any more, so they are no longer operational. Can't sample from these wells. Overall, they have lost wells to attrition because of this. Does foresee this continuing into the future, but believe the remaining wells are enough to properly characterize the site. The wells lost tend to be on the fringes of the monitoring area, not near the main plume or the 5 µg/L contour.

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
N/A

10) Do you have any comments, suggestions, or recommendations regarding the project?
No.

Additional Site-Specific Questions

11) Is it your responsibility to identify new wells to add to sampling scheme?
Yes. CAPE does a review of new wells each year. They reach out the state regulatory agency to get list of wells in the area. Review the spreadsheet provided by the state compared to their current sampling wells. There is no established "area of interest" for the site. To determine if a well should be added, look at it based on proximity to plume and other wells sampled nearby. Only a few wells go in each year.

Five-Year Review Interview Record			
Site:	Schofield Barracks, OU 2&4	**EPA ID No:**	HI7210090026

Interview Type: Telephone
Date: 8 March 2017
Time: 1500 Pacific / 1300 Hawaii

Interviewers

Name	Title	Organization
Kayla Patten	Environmental Engineer	USACE
Peter Gibson	Biologist	USACE

Interviewees

Name	Organization	Title	Telephone	Email
Wayde Nakai	Schofield Barracks, DPW	Water Treatment Plant Supervisor	808-655-1772	wayde.t.nakai.civ@mail.mil

Summary of Conversation

1) What is your overall impression of the project?
Running fine.

2) Is the remedy functioning as expected? How well is the remedy performing?
Yes. Running way better than expected. There is some corrosion around piping, to and from the air stripping towers. There is regular maintenance that needs to be done. Currently planning on getting the piping below the walkway grating cleaned and re painted. Also cleaning out water distribution tanks. Tanks should be cleaned every 3-5 years, but some haven't ever been cleaned. Need to remove sedimentation.

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?
Daily flow rate is about 2.8-4.5 MGD. This did go down recently because a golf course was removed from the distribution system. Have not seen issues with TCE. The environmental group has more data on the TCE.

4) Is there a continuous O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.
His crew works (in total) 7-day shifts from 0700-1530. Staff is spilt between all the Army sites (e.g. Fort Shafter, Tripler, Wheeler Army Airfield, and Schofield Barracks). An operator isn't on-site at Schofield all the time, but is on-call. SCADA system is set up to call the operators if there is an issue.

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
No major changes.

6) What are the annual operating costs for your organization's involvement with the site?
**Will follow up after the interview to gather this information.*

7) Have there been unexpected O&M difficulties or costs at the site in the last five years? If so, please give details.
No.

8) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
**Will follow up after the interview to gather this information.* Wayde would like to ask his operators their opinions too.

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
N/A

10) Do you have any comments, suggestions, or recommendations regarding the project?
Wayde had comments on a few long-term goals for the plant:

- Have the air stripping towers redone. Would like to replace the packing inside the towers. Hoping, within the next five years. Right now the pack looks good, but it is reaching the end of its expected life.
- Move the pumps above ground. Currently they are in a tunnel below the site which means staff must access via a cart, which takes 12 minutes. If the cart is broken then can't do maintenance or would need to walk the stairs. Accessing via the cart is time consuming.
- Possibility of moving extraction wells to higher elevation so full system can be gravity fed.

Appendix C OU 2 Site Inspection Report

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Trip Report
Schofield Barracks, OU 2 – Groundwater
Oahu, Hawaii

1. INTRODUCTION

a. Date of Visit: 18 January 2017

b. Location: Schofield Barracks, Oahu, Hawaii

c. Purpose: A site visit was conducted to visually inspect and document the conditions of the remedy, the site, and the surrounding area for inclusion into the Five-Year Review Report.

d. Participants:

Carrie Nelson	Schofield Barracks, Directorate of Public Works	808-864-1002
Lisa Wurlitzer	Schofield Barracks, Directorate of Public Works	808-656-3090
Kayla Patten	Seattle USACE, Environmental Engineer	206-316-3855
Blair Kinser	Seattle USACE, Environmental Engineer	206-764-6875

2. SUMMARY

The site visit team toured the main treatment plant and operations building. The piping was largely in good condition; however, some small leaks were observed. The air stripper towers were in good working order. The plant operator indicated that influent water is treated with chlorine prior to going through the air stripper, so the air strippers have not had an issue with biofouling. The extraction pumps were located in a tunnel beneath the site. Due to access limitations, these pumps were not inspected. The rail-cart used to reach the pumps was operational. The fence around the main treatment plant was not damaged; however, past repairs were evident. The plant operator said trespassing is an issue and that there was one incident of theft at the site.

The team also toured the Kunia treatment plant. Due to equipment failure, the treatment plant was not operational at the time of the site visit. The community served by the treatment plant had been connected to the USAG-HI drinking water system instead. The equipment appeared to be in fair condition. The fence surrounding the site was not damaged and did not show signs of unauthorized access.

3. DISCUSSION

The site visit at the main treatment plant occurred from 8:30 to 9:00 am. The weather was sunny with temperatures around 75°F. The plant operator indicated that maintenance was largely conducted as needed, and that little preventative maintenance is completed due to staff and budget constraints.

The site visit of the Kunia treatment plant occurred from 10:45 to 11:00 am. Because the plant was not operational and a maintenance worker was onsite, minimal inspection of the plant was conducted.

4. ACTIONS

USACE will incorporate information obtained from the site visit into the Five Year Review report.

Kayla Patten
Environmental Engineer, EIT
CENWS-EN-TS-ET

MAIN TREATMENT PLANT

Figure C-1. Treatment plant piping.

Figure C-2. Blower for an air stripper.

Figure C-3. Flow meter.

Figure C-4. Five air stripper towers, front and back.

Figure C-5. Tunnel to the extraction pumps.

Figure C-6. Fencing.

KUNIA TREATMENT PLANT

Figure C-7. Kunia treatment plant; pump house and air stripping tower.

Figure C-8. Kunia air stripping tower and blower.

Figure C-9. Kunia treatment system piping.

Figure C-10. Fence and signs at the Kunia treatment system.

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION

Site name: OU 2, Groundwater	**Date of inspection:** 18 January 2017
Location: Schofield Barracks, Oahu, Hawaii	**EPA ID:** HI7210090026
Agency, office, or company leading the five-year review: USACE, Seattle District	**Weather/temperature:** Sunny, 75°F

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☐ Access controls
- ☐ Institutional controls
- ☒ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Other:
- ☐ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

Interviews were not conducted at the site visit. They will be conducted later via phone.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

☒ O&M manual	☒ Readily available	☒ Up to date	☐ N/A
☐ As-built drawings	☐ Readily available	☐ Up to date	☒ N/A
☒ Maintenance logs	☒ Readily available	☒ Up to date	☐ N/A

Remarks_____

2. **Site-Specific Health and Safety Plan** ☐ Readily available ☐ Up to date ☐ N/A
   ☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☐ N/A
   Remarks_____

3. **O&M and OSHA Training Records** ☐ Readily available ☐ Up to date ☐ N/A
   Remarks_____

4. **Permits and Service Agreements**

☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
☐ Effluent discharge	☐ Readily available	☐ Up to date	☒ N/A
☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A
☐ Other permits_____	☐ Readily available	☐ Up to date	☒ N/A

Remarks DPW staff indicated that no air discharge permit is required._____

7. **Groundwater Monitoring Records** ☒ Readily available ☒ Up to date ☐ N/A
   Remarks_____

9. **Discharge Compliance Records**

☐ Air	☐ Readily available	☐ Up to date	☒ N/A
☐ Water (effluent)	☐ Readily available	☐ Up to date	☒ N/A

Remarks_____

10. **Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☒ N/A
Remarks_____

IV. O&M COSTS

1. **O&M Organization**
☐ State in-house ☐ Contractor for State
☐ PRP in-house ☐ Contractor for PRP
☒ Federal Facility in-house ☐ Contractor for Federal Facility
☐ Other_____

2. **O&M Cost Records**
☐ Readily available ☐ Up to date ☐ Funding mechanism/agreement in place
Original O&M cost estimate_____ ☐ Breakdown attached

Total annual cost by year for review period if available

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost
From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost
From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost
From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost
From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons:

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☐ Gates secured ☐ N/A
Remarks Fencing was in good condition. Previous repairs had been made to the fencing.

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A
Remarks Site access to the main treatment site is restricted through a keypad locked gate. Access to the Kunia site is through a padlocked gate.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented ☒ Yes ☐ No ☐ N/A

Site conditions imply ICs not being fully enforced ☒ Yes ☐ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) Groundwater monitoring

Frequency Quarterly

Responsible party/agency CAPE (USAG-HI contractor)

Contact _____ _____ _____ _____

Name Title Date Phone no.

Reporting is up-to-date ☒ Yes ☐ No ☐ N/A

Reports are verified by the lead agency ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A

Violations have been reported ☐ Yes ☒ No ☐ N/A

Other problems or suggestions: ☐ Report attached

_____

_____

_____

_____

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A

Remarks:

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident

Remarks: The site manager did report an incident of unauthorized access and theft of equipment in the past.

2. **Land use changes on site** ☐ N/A

Remarks:

3. **Land use changes off site** ☐ N/A

Remarks:

VI. GENERAL SITE CONDITIONS

A. Roads ☐ Applicable ☒ N/A

B. Other Site Conditions

Remarks:

VII. LANDFILL COVERS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
☐ Good condition ☐ All required wells properly operating ☒ Needs Maintenance ☐ N/A
Remarks: At the main plant pumps and piping were in fair condition but showed signs of aging and wear. Some small leaks were observed. The Kunia plant was not operational due to broken extraction pumps.

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☒ Good condition ☐ Needs Maintenance
Remarks: At the main plant extraction pumps and piping were not inspected. They are located in a tunnel beneath the treatment system and were not accessible. The extraction system at the Kunia plant was not inspected since it is not currently operational.

3. **Spare Parts and Equipment**
☒ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
☒ Air stripping ☐ Carbon adsorbers
☐ Filters
☐ Additive (*e.g.*, chelation agent, flocculent)
☐ Others
☒ Good condition ☐ Needs Maintenance
☐ Sampling ports properly marked and functional
☐ Sampling/maintenance log displayed and up to date
☒ Equipment properly identified
☐ Quantity of groundwater treated annually
☐ Quantity of surface water treated annually
Remarks: The treatment system at the Kunia plant needs maintenance. Due to broken equipment, the treatment system was not operational at the time of the site inspection.

2. **Electrical Enclosures and Panels** (properly rated and functional)
☐ N/A ☒ Good condition ☐ Needs Maintenance
Remarks

3. **Tanks, Vaults, Storage Vessels**
☒ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
Remarks

4. **Discharge Structure and Appurtenances**
☒ N/A ☐ Good condition ☐ Needs Maintenance
Remarks Discharge is to the drinking water distribution system.

5. **Treatment Building(s)**

☒ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair

☐ Chemicals and equipment properly stored

Remarks

6. **Monitoring Wells** (pump and treatment remedy)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ All required wells located ☐ Needs Maintenance ☐ N/A

Remarks Monitoring wells were not observed during the site visit.

D. Monitoring Data

1. **Monitoring Data**

☒ Is routinely submitted on time ☒ Is of acceptable quality

2. **Monitoring data suggests**:

☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

E. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ All required wells located ☐ Needs Maintenance ☒ N/A

Remarks

X. OTHER REMEDIES

None.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

The remedy is for wellhead treatment to prevent contaminated water from being used as drinking water. The main treatment system for the Schofield Barracks is in good working order and running as designed. The treatment system at Kunia is not currently operational due to failure of the extraction pumps maintained by Kunia Village. The community is currently connected to the Schofield Barracks water supply.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Maintenance of the main treatment plant is completed as needed. The site manager indicated little preventative maintenance is completed. Groundwater monitoring is completed quarterly throughout the site. No issues were evident from the groundwater monitoring reports.

C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. No indicators of potential remedy problems were observed.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. The extraction wells are in a tunnel below the main facility. Because of this, access is limited and special equipment is required to get down to the wells. The site manager expressed interest in bringing the wells up to the surface for easier access, which is a good opportunity to optimize the remedy operation, but it would be a significant undertaking.

Appendix D OU 4 Site Inspection Report

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Trip Report
Schofield Barracks, OU 4 – Former Landfill
Oahu, Hawaii

1. INTRODUCTION

a. Date of Visit: 18 January 2017

b. Location: Schofield Barracks

c. Purpose: A site visit was conducted to visually inspect and document the conditions of the landfill cap, the site, and the surrounding area for inclusion into the Five-Year Review report.

d. Participants:

Carrie Nelson	Schofield Barracks, Directorate of Public Works	808-864-1002
Lisa Wurlitzer	Schofield Barracks, Directorate of Public Works	808-656-3090
Kayla Patten	Seattle USACE, Environmental Engineer	206-316-3855
Blair Kinser	Seattle USACE, Environmental Engineer	206-764-6875

2. SUMMARY

Due to the large area of the former landfill, participants traveled throughout the site by car. Participants drove the inner fence line counter-clockwise and stopped at major landmarks for a more detailed inspection. The entry gate was locked and all warning signs were present and in good condition. The landfill cap was well vegetated with healthy grass. No cracks, bulges, or other landfill cap issues were noted. The fence line along the western edge showed many repair sites; however, no current damage was visible. The remaining fences were in good condition. The western drainage channel was clear of debris and no water was ponding. The northwest drainage geofabric was in very good condition, and minimal debris was present at the outlet. The central drainage channel was also in good condition. The base of the channel consisted of dried mud (i.e. unvegetated surface), and it is unlikely this was sedimentation. The outlet was clear of debris. The steep slope on the north and eastern side of the landfill showed no erosion or slumping. All gas monitoring wells observed appeared to be in good condition; no damage was present to the wells. Monitoring well MW 4-4 was locked and in good condition.

3. DISCUSSION

Weather during the site visit was in the mid-70s and clear skies. The inspection began around 1100 and concluded around 1200. Ms. Nelson indicated that this is the rainy season for the area, and so the vegetation was particularly healthy and abundant. Ms. Nelson also indicated that the western fence abuts a training area, which results in regular damage to the fence. Repairs are made promptly. The geofabric at the northwestern drainage was recently replaced (within a few months).

4. ACTIONS

The USACE will incorporate information obtained from the site visit into the Five-Year Review report.

Kayla Patten
Environmental Engineer
CENWS-EN-TS-ET

Figure D-1. Landfill entry gate and signs


Figure D-2. Repairs along western fence


Figure D-3. Western fence

Figure D-4. Irrigation sprinkler

Figure D-5. Western landfill cap surface

Figure D-6. Western drainage channel

Figure D-7. Northwest drainage channel

Figure D-8. Central drainage channel outlet

Figure D-9. Central drainage channel

Figure D-10. Gas monitoring well

Figure D-11. Groundwater monitoring well

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION

Site name: OU 4 – Former Landfill	**Date of inspection:** 18 January 2017
Location: Schofield Barracks, Oahu, Hawaii	**EPA ID:** HI7210090026
Agency, office, or company leading the five-year review: USACE, Seattle District	**Weather/temperature:** Sunny, 75°F

Remedy Includes: (Check all that apply)

- ☒ Landfill cover/containment
- ☒ Access controls
- ☐ Institutional controls
- ☐ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Other:
- ☐ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☒ Site map attached

II. INTERVIEWS (Check all that apply)

Interviews were not conducted at the time of the site inspection. They will be scheduled for a later date.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

☐ O&M manual	☐ Readily available	☐ Up to date	☐ N/A
☐ As-built drawings	☐ Readily available	☐ Up to date	☐ N/A
☒ Maintenance logs	☐ Readily available	☐ Up to date	☐ N/A

Remarks_____

2. **Site-Specific Health and Safety Plan** ☐ Readily available ☐ Up to date ☒ N/A
   ☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☒ N/A
   Remarks_____

3. **O&M and OSHA Training Records** ☐ Readily available ☐ Up to date ☒ N/A
   Remarks_____

4. **Permits and Service Agreements**

☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
☐ Effluent discharge	☐ Readily available	☐ Up to date	☒ N/A
☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A
☐ Other permits_____	☐ Readily available	☐ Up to date	☒ N/A

Remarks_____

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A
   Remarks: The landfill is old and no longer generates significant gas._____

6. **Settlement Monument Records** ☐ Readily available ☐ Up to date ☒ N/A
   Remarks_____

7. **Groundwater Monitoring Records** ☒ Readily available ☐ Up to date ☐ N/A
Remarks: Groundwater monitoring near the landfill is conducted in conjunction with the site-wide groundwater monitoring efforts.

8. **Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A
Remarks

9. **Discharge Compliance Records**
☐ Air ☐ Readily available ☐ Up to date ☒ N/A
☐ Water (effluent) ☐ Readily available ☐ Up to date ☒ N/A
Remarks

10. **Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☒ N/A
Remarks: Site is locked and only accessible by authorized personnel with a key.

IV. O&M COSTS

1. **O&M Organization**
☐ State in-house ☐ Contractor for State
☐ PRP in-house ☐ Contractor for PRP
☐ Federal Facility in-house ☒ Contractor for Federal Facility
☐ Other

2. **O&M Cost Records**
☐ Readily available ☐ Up to date ☐ Funding mechanism/agreement in place

Remarks: O&M contractor was not present at the site inspection. Costs will be obtained from them during the interview process.

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons:

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A
Remarks: No fencing damage was observed; however, many repairs were noted along western fence. According to Carrie Nelson, this fence abuts a troop training ground, which regularly causes damage to the fence.

B. Other Access Restrictions

1. **Signs and other security measures** ☒ Location shown on site map ☐ N/A
Remarks: Signs were present and in good condition.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A

Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) visual inspection of site and fenceline

Frequency Quarterly

Responsible party/agency CAPE (contractor)

Contact Troy Rosenbush _____ _____ 808-791-6890

Name Title Date Phone no.

Reporting is up-to-date ☒ Yes ☐ No ☐ N/A

Reports are verified by the lead agency ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ☒ N/A

Violations have been reported ☐ Yes ☒ No ☐ N/A

Other problems or suggestions: ☐ Report attached

The landfill grass cover was in excellent condition at the site-visit. The fence did not have any damage.

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A

Remarks:

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident

Remarks: No trespassing was observed. The western fence line is regularly damaged by adjacent troop training activities.

2. **Land use changes on site** ☐ N/A

Remarks:

3. **Land use changes off site** ☐ N/A

Remarks:

VI. GENERAL SITE CONDITIONS

A. Roads ☐ Applicable ☒ N/A

B. Other Site Conditions

Remarks: The landfill cap was in very good condition. The fence showed no damage.

VII. LANDFILL COVERS ☒ Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident
   Areal extent_____ Depth_____
   Remarks_____

2. **Cracks** ☐ Location shown on site map ☒ Cracking not evident
   Lengths_____ Widths_____ Depths_____
   Remarks The grass vegetative cover was very well established. This could obscure smaller cracking.

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
   Areal extent_____ Depth_____
   Remarks_____

4. **Holes** ☐ Location shown on site map ☒ Holes not evident
   Areal extent_____ Depth_____
   Remarks: Feral pigs are present in the site vicinity, but no digging or holes were observed.

5. **Vegetative Cover** ☒ Grass ☒ Cover properly established
   ☐ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram)
   Remarks Vegetation was very healthy. This is the rainy season, partially contributing to the robust vegetation. Past inspection reports do indicate dry patches during other times of the year.

6. **Alternative Cover (armored rock, concrete, etc.)** ☒ N/A
   Remarks_____

7. **Bulges** ☐ Location shown on site map ☒ Bulges not evident
   Areal extent_____ Height_____
   Remarks_____

8. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident
   ☐ Wet areas ☐ Location shown on site map Areal extent_____
   ☐ Ponding ☐ Location shown on site map Areal extent_____
   ☐ Seeps ☐ Location shown on site map Areal extent_____
   ☐ Soft subgrade ☐ Location shown on site map Areal extent_____
   Remarks: It had not rained at the site in several days. Ponding was not evident.

9. **Slope Instability** ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability
   Areal extent_____
   Remarks:

B. Benches ☐ Applicable ☒ N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

C. Letdown Channels ☐ Applicable ☒ N/A

(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

D. Cover Penetrations ☒ Applicable ☐ N/A

1. **Gas Vents** ☐ N/A ☐ Active ☐ Passive ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☒ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance
   Remarks: Gas monitoring ceased in 2007. Monitoring wells are present and in good condition.

2. **Gas Monitoring Probes**
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A
   Remarks

3. **Monitoring Wells** (within surface area of landfill)
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A
   Remarks

4. **Leachate Extraction Wells**
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A
   Remarks

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☒ N/A
   Remarks

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☐ Applicable ☒ N/A

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☐ Applicable ☒ N/A

I. Perimeter Ditches/Off-Site Discharge ☒ Applicable ☐ N/A

1. **Siltation** ☐ Location shown on site map ☒ Siltation not evident
   Areal extent_____ Depth_____
   Remarks

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A
   ☒ Vegetation does not impede flow
   Areal extent_____ Type_____
   Remarks

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
   Areal extent_____ Depth_____
   Remarks

4. **Discharge Structure** ☒ Functioning ☐ N/A
   Remarks

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A

Groundwater monitoring near the landfill is conducted as part of the larger site-wide groundwater monitoring effort.

X. OTHER REMEDIES

None

XI. OVERALL OBSERVATIONS	
A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). The remedy is functioning as designed. The vegetative cover is well established and no bare spots were observed at the site visit; however, past monitoring reports have observed small bare areas during the dry season. Fencing and natural physical barriers (steep slopes) appear to be effective in preventing site access. The drainage channels appear to be properly draining the site as no ponding or siltation was evident. No cracks, bulges, or settling was evident in the cap surface
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. The grass covered was well maintained. At the site visit the grass was somewhat tall, and would likely need mowing soon. Repairs to the fencing were completed properly and, according to inspection records, promptly. Damage to the northwest drainage geofabric was repaired and the current geofabric was in very good condition. O&M appears to be adequate to maintain the integrity of the remedy.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. No issues to the remedy were observed during the site visit. DPW staff did indicate that adjacent troop training causes regular damage to the fencing that requires regular maintenance. There is no evidence that troops are gaining access to the site during training so protectiveness of the remedy is not affected.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. DPW staff should consider working with the troop training groups to determine why the fencing is regularly damaged. Reducing the need for regular maintenance will reduce cost of O&M. for the remedy

Appendix E Groundwater Data Mann-Kendall Trend Analysis Results

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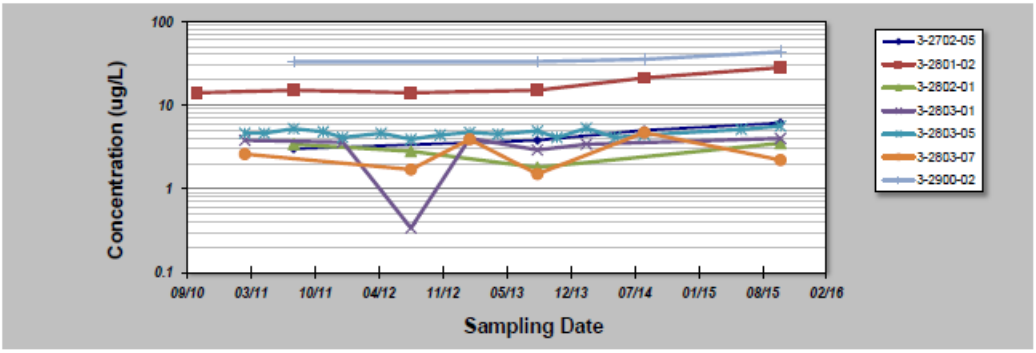
GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: 24-Mar-17
Facility Name: Schoefield OU2 and OU4
Conducted By: Jeffrey Weiss

Job ID: Fourth, 5-Year Review
Constituent: TCE
Concentration Units: ug/L

Sampling Point ID:	3-2702-05	3-2801-02	3-2802-01	3-2803-01	3-2803-05	3-2803-07	3-2900-02
Sampling Event	Sampling Date	TCE CONCENTRATION (ug/L)						
1	1-Oct-10		14					
2	1-Mar-11				3.8	4.6	2.6	
3	1-May-11					4.6		
4	1-Aug-11	3	15	3.4		5.2		33
5	1-Nov-11					4.8		
6	1-Jan-12				3.6	4.1		
7	1-May-12					4.6		
8	1-Aug-12		14	2.8	0.34	3.9	1.7	
9	1-Nov-12					4.4		
10	1-Feb-13				4	4.7	3.9	
11	1-May-13					4.5		
12	1-Sep-13	3.8	15	1.8	2.9	4.9	1.5	33
13	1-Nov-13					4.1		
14	1-Feb-14				3.4	5.3		
15	1-May-14					4.1		
16	1-Aug-14	5	21			4.4	4.7	35
17	1-Jun-15					5.1		
18	1-Oct-15	6.1	28	3.5	4	5.6	2.2	43
19								
20								
Coefficient of Variation:		0.30	0.32	0.27	0.41	0.10	0.46	0.13
Mann-Kendall Statistic (S):		6	11	0	2	15	1	5
Confidence Factor:		95.8%	97.2%	37.5%	55.7%	71.5%	50.0%	89.6%
Concentration Trend:		Increasing	Increasing	Stable	No Trend	No Trend	No Trend	No Trend



Notes:

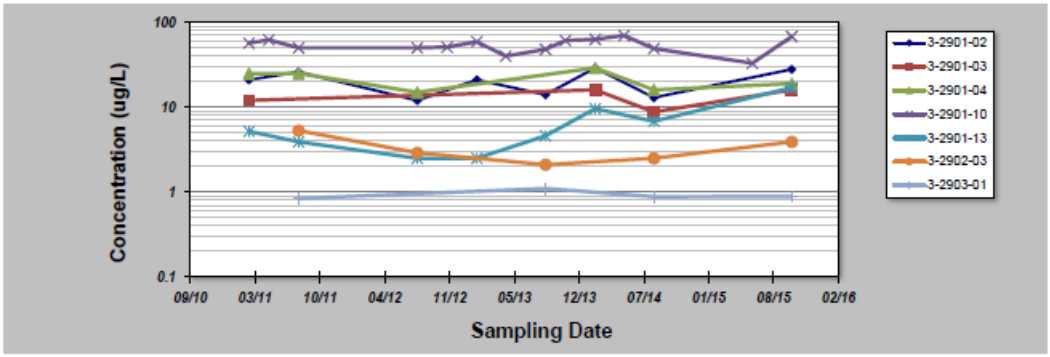
1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
3. Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: 24-Mar-17
Facility Name: Schoefield OU2 and OU4
Conducted By: Jeffrey Weiss

Job ID: Fourth, 5-Year Review
Constituent: TCE
Concentration Units: ug/L

Sampling Point ID:	3-2901-02	3-2901-03	3-2901-04	3-2901-10	3-2901-13	3-2902-03	3-2903-01
Sampling Event	Sampling Date	TCE CONCENTRATION (ug/L)						
1	1-Oct-10							
2	1-Mar-11	21	12	25	57	5.2		
3	1-May-11				62			
4	1-Aug-11	26		25	50	3.9	5.3	0.84
5	1-Nov-11							
6	1-Jan-12							
7	1-May-12							
8	1-Aug-12	12		15	50	2.5	2.9	
9	1-Nov-12				51			
10	1-Feb-13	21			59	2.5		
11	1-May-13				40			
12	1-Sep-13	14			48	4.6	2.1	1.1
13	1-Nov-13				61			
14	1-Feb-14	29	16	29	63	9.6		
15	1-May-14				70			
16	1-Aug-14	13	8.8	16	49	6.8	2.5	0.88
17	1-Jun-15				33			
18	1-Oct-15	28	16	19	68	17	3.9	0.89
19								
20								
Coefficient of Variation:		0.33	0.26	0.26	0.19	0.74	0.38	0.13
Mann-Kendall Statistic (S):		3	1	-2	6	13	-2	2
Confidence Factor:		59.4%	50.0%	57.0%	60.6%	92.9%	59.2%	62.5%
Concentration Trend:		No Trend	No Trend	Stable	No Trend	Prob. Increasing	Stable	No Trend



Notes:

1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
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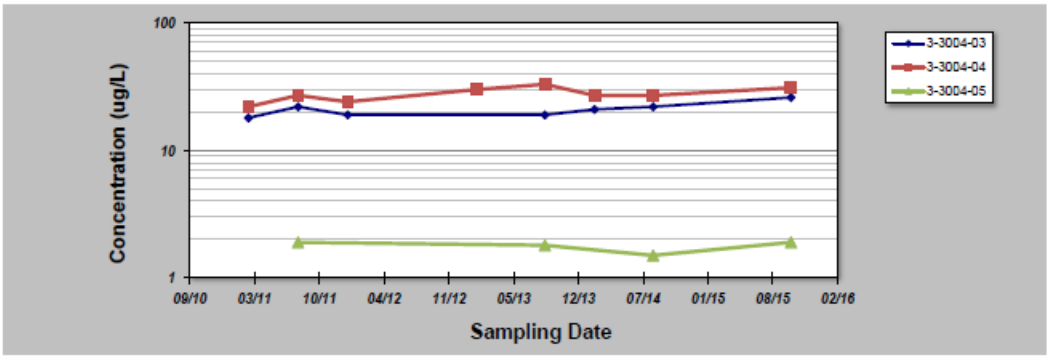
GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: 24-Mar-17
Facility Name: Schoefield OU2 and OU4
Conducted By: Jeffrey Weiss

Job ID: Fourth, 5-Year Review
Constituent: TCE
Concentration Units: ug/L

Sampling Point ID:	3-3004-03	3-3004-04	3-3004-05				
Sampling Event	Sampling Date	TCE CONCENTRATION (ug/L)						
1	1-Oct-10							
2	1-Mar-11	18	22					
3	1-May-11							
4	1-Aug-11	22	27	1.9				
5	1-Nov-11							
6	1-Jan-12	19	24					
7	1-May-12							
8	1-Aug-12							
9	1-Nov-12							
10	1-Feb-13		30					
11	1-May-13							
12	1-Sep-13	19	33	1.8				
13	1-Nov-13							
14	1-Feb-14	21	27					
15	1-May-14							
16	1-Aug-14	22	27	1.5				
17	1-Jun-15							
18	1-Oct-15	26	31	1.9				
19								
20								
Coefficient of Variation:		0.13	0.13	0.11				
Mann-Kendall Statistic (S):		13	13	-1				
Confidence Factor:		96.5%	92.9%	50.0%				
Concentration Trend:		Increasing	Prob. Increasing	Stable				



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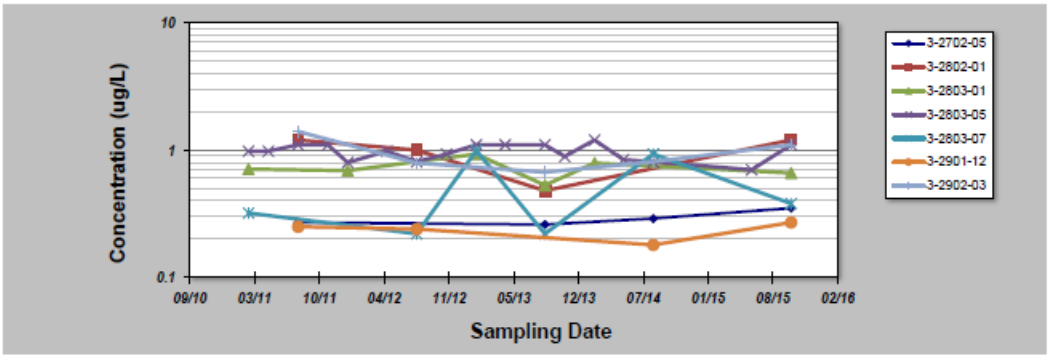
GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: 24-Mar-17
Facility Name: Schoefield OU2 and OU4
Conducted By: Jeffrey Weiss

Job ID: Fourth, 5-Year Review
Constituent: Carbon Tetrachloride
Concentration Units: ug/L

Sampling Point ID:	3-2702-05	3-2802-01	3-2803-01	3-2803-05	3-2803-07	3-2901-12	3-2902-03
Sampling Event	Sampling Date	CARBON TETRACHLORIDE CONCENTRATION (ug/L)						
1	1-Oct-10							
2	1-Mar-11			0.71	0.98	0.32		
3	1-May-11				0.98			
4	1-Aug-11	0.27	1.2		1.1		0.25	1.4
5	1-Nov-11				1.1			
6	1-Jan-12			0.69	0.8			
7	1-May-12				0.98			
8	1-Aug-12		1		0.81	0.22	0.24	0.79
9	1-Nov-12				0.93			
10	1-Feb-13			0.93	1.1	0.99		
11	1-May-13				1.1			
12	1-Sep-13	0.26	0.48	0.53	1.1	0.22		0.67
13	1-Nov-13				0.89			
14	1-Feb-14			0.79	1.2			
15	1-May-14				0.84			
16	1-Aug-14	0.29			0.81	0.93	0.18	0.81
17	1-Jun-15				0.7			
18	1-Oct-15	0.35	1.2	0.66	1.1	0.38	0.27	1.1
19								
20								
Coefficient of Variation:		0.14	0.35	0.19	0.15	0.69	0.16	0.31
Mann-Kendall Statistic (S):		4	-1	-3	-11	2	0	0
Confidence Factor:		83.3%	50.0%	64.0%	65.7%	57.0%	37.5%	40.8%
Concentration Trend:		No Trend	Stable	Stable	Stable	No Trend	Stable	Stable



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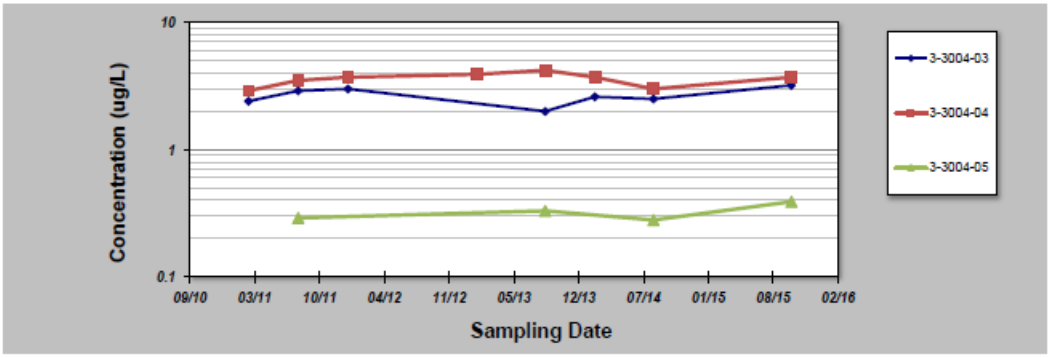
GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: 24-Mar-17
Facility Name: Schoefield OU2 and OU4
Conducted By: Jeffrey Weiss

Job ID: Fourth, 5-Year Review
Constituent: Carbon Tetrachloride
Concentration Units: ug/L

Sampling Point ID:	3-3004-03	3-3004-04	3-3004-05				
Sampling Event	Sampling Date	CARBON TETRACHLORIDE CONCENTRATION (ug/L)						
1	1-Oct-10							
2	1-Mar-11	2.4	2.9					
3	1-May-11							
4	1-Aug-11	2.9	3.5	0.29				
5	1-Nov-11							
6	1-Jan-12	3	3.7					
7	1-May-12							
8	1-Aug-12							
9	1-Nov-12							
10	1-Feb-13		3.9					
11	1-May-13							
12	1-Sep-13	2	4.2	0.33				
13	1-Nov-13							
14	1-Feb-14	2.6	3.7					
15	1-May-14							
16	1-Aug-14	2.5	3	0.28				
17	1-Jun-15							
18	1-Oct-15	3.2	3.7	0.39				
19								
20								
Coefficient of Variation:		0.15	0.12	0.15				
Mann-Kendall Statistic (S):		5	7	2				
Confidence Factor:		71.9%	76.4%	62.5%				
Concentration Trend:		No Trend	No Trend	No Trend				



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